THE TAXONOMY OF PLANTS FORMERLY REFERRED TO ONCIDIUM SECTION ONCIDIUM (ORCHIDACEAE) IN THE CARIBBEAN ISLANDS

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ABSTRACT

The taxonomic affinities of the plants formerly referred to Oncidium section Oncidium (Orchidaceae) in the Caribbean Islands have been studied with respect to morphological, cytogenetical, biochemical and geographic data. The data was examined employing numerical taxonomic methods.
The study involved 57 taxa (28 taxa of the plants belonging to the orchid group studied and 29 related species) and a total of 63 attributes.

The literature and all available herbarium specimens concerning the plants studied were viewed critically. This resulted in the clarification of some problems of identification and taxonomy. The plants studied were reclassified into the genera Braasiella, Hispaniella, Olgasis and Tolumnia.

For all but one species formerly referred to Oncidium section Oncidium, living material was obtained through purchase, donation or through personal collecting in the Caribbean Islands. Living plants were examined in respect to morphological and ultrastructural characters. For all but three taxa, the chromosome number (2n) was determined. The data obtained was compared with the data formerly reported. For nine taxa, the diploid chromosome numbers are reported for the first time.

Field studies were performed in selected areas of Jamaica, Haiti and the Dominican Republic to determine some aspects of the pollination ecology, ecology and distribution of some of the taxa.

Leaf flavonoid fingerprinting was performed on material obtained from all 57 taxa studied, using two dimensional paper chromatography.

All data obtained was collated using numerical taxonomic methods.

It became apparent during this study that a number of previously described taxa needed clarification as far as their identity is concerned. Furthermore, it became apparent that the species formerly referred to Oncidium sect. Oncidium differ from all other groups of the genus Oncidium sensu Garay and Stacy, as well as from all genera within the Oncidiinae, in such a way as to warrant their separation as autonomous genera. These have been published by Rafinesque (1837), Braem (1980) and Braem et al. (1984).

This work also shows the difficulty of gaining total objectivity in a systematic study. The main problems arise from the selection of attributes, and the difficulties experienced in the coding of the data.

TO MY WIFE GUDRUN

For many years of patience, understanding and encouragement, I dedicate this thesis, knowing well, that without her love and selflessness this work would have never been possible.

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I certify that this thesis is my own work and has not been submitted for any degree other than that of Doctor of Philosophy in the University of Newcastle upon Tyne

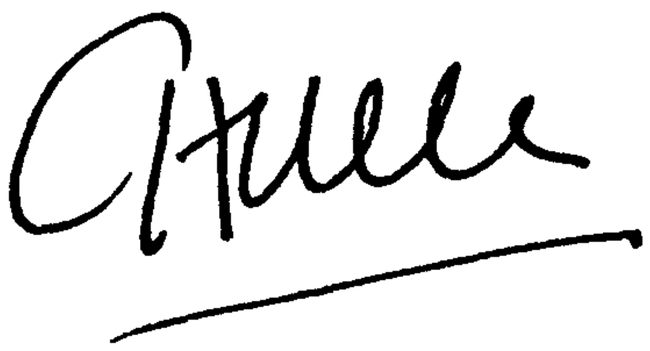

TABLE OF CONTENTS:

Abstract.....2

Dedication.....4

Acknowledgements.....5

Table of contents.....7

List of tables.....11

List of figures.....13

Preliminary remark.....20

1. INTRODUCTION.....21

2. CLASSIFICATION OF THE FAMILY ORCHIDACEAE Jussieu

A brief history.....24

3. THE GENUS ONCIDIUM Swartz.....34

3. 1. General remarks.....34

3. 2. Revisions of the genus Oncidium Swartz.....41

3. 2. 1. Survey and typification.....41

3. 2. 2. Oncidium section Oncidium.....45

3. 2. 2. 1. Garay and Stacy's concept.....45

4. REVISION OF ONCIDIUM SECTION ONCIDIUM.....49

4. 1. Herbarium work and literature search.....49

4. 1. 1. Herbarium work.....49

4. 1. 2. Literature search.....51

4. 1. 3. Conclusions.....54

4. 2. Reclassification of the "Variegata" Oncidiums.....60

4. 2. 1. Synopsis of the genus Braasiella Braem et al.63

4. 2. 2. Synopsis of the genus Hispaniella Braem.....64

4. 2. 3. Synopsis of the genus Olgasis Rafinesque.....65

4. 2. 4. Synopsis of the genus Tolumnia Rafinesque....67

4. 3. Field work.....96
4. 3. 1. Origin and maintenance of living material....96
4. 3. 1. 1. General review of collecting trips.....96
4. 3. 1. 2. Provenance of living material.....98
4. 3. 1. 3. Maintenance of living material.....106
4. 3. 2. Field analysis.....107
4. 3. 2. 1. Distribution of the taxa.....107
4. 3. 2. 2. Ecological observations.....118
4. 3. 2. 2. 1. General information.....118
4. 3. 2. 2. 2. Natural habitats.....120
4. 3. 2. 2. 3. Pollination.....125
4. 3. 2. 2. 3. 1. Introduction and summary of pertinent literature.....125
4. 3. 2. 2. 3. 2. Observations on pollination in specific areas.....131
4. 3. 2. 2. 3. 3. Discussion.....136
4. 4. Morphology.....138
4. 4. 1. Vegetative morphology.....138
4. 4. 2. Floral morphology.....142
4. 4. 2. 1. Inflorescence.....142
4. 4. 2. 2. Flower morphology.....143
4. 4. 2. 2. 1. Introduction.....143
4. 4. 2. 2. 2. Overall morphology.....145
4. 4. 2. 2. 3. Flower colour.....150
4. 4. 2. 2. 4. Perianth morphology.....158
4. 4. 2. 2. 5. The column and associated structures.....164
4. 4. 2. 2. 5. 1. Introduction.....164
4. 4. 2. 2. 5. 2. Tabula infrastigmatica....166
4. 4. 2. 2. 5. 3. Anther.....168

4. 4. 2. 2. 5. 4. Pollinia and Pollinaria...169
4. 4. 2. 2. 6. Seed capsule.....180
4. 4. 2. 2. 7. Seed.....181
4. 4. 3. Conclusion.....188
4. 5. Chromosome numbers.....191
4. 5. 1. Introduction and review of pertinent literature.....191
4. 5. 2. Chromosome counting.....203
4. 5. 2. 1. Materials and methods.....203
4. 5. 2. 1. 1. Preparation of 8-hydroxyquinoline.....203
4. 5. 2. 1. 2. Fixative.....203
4. 5. 2. 1. 3. Hydrochloric acid.....203
4. 5. 2. 1. 4. Feulgen stain.....204
4. 5. 2. 1. 5. Root squash technique for counting chromosomes within the Oncidiinae.....204
4. 5. 2. 2. Results.....207
4. 5. 2. 3. Discussion.....215
4. 6. Leaf flavonoid fingerprinting.....217
4. 6. 1. Introduction and review of pertinent literature.....217
4. 6. 2. Two-dimensional paper chromatography of leaf flavonoids.....219
4. 6. 2. 1. Materials and methods.....219
4. 6. 2. 2. Results.....220
4. 7. Numerical analysis.....227
4. 7. 1. Introduction.....227
4. 7. 2. The coefficients of similarity.....229
4. 7. 3. Clustering methods.....229

4. 7. 4. Data.....230

4. 7. 5. Results.....238

4. 7. 6. Discussion.....247

5. GENERAL DISCUSSION.....255

6. LITERATURE CITED.....262

Annex I : List of plants described as Oncidium-species with indication of synonymity and references to the sections as described by Garay and Stacy (1974).....275

Annex II : Scored data for Computer analysis.....300

Annex III: Key to the taxa of the "Variegata" as treated in this thesis.....313

LIST OF TABLES :

1. System of the Orchidaceae according to O. Swartz (1800)
2. System of the Orchidaceae according to J. Lindley (1830-1840)
3. Comparison of the major systems of orchid classification
4. Description of the genus Oncidium by Swartz (1800) Photocopy of the original.
5. Position of the genus Oncidium Swartz in Dressler's system.
6. Taxa included in Oncidium section Oncidium by Garay and Stacy (1974).
7. Taxa belonging to Oncidium section Oncidium as found in the literature.
8. Species formerly classified in Oncidium section Oncidium and their classification into separate genera.
9. Distribution of taxa.
10. Pollination syndromes associated with different pollinator classes with special reference to orchids.
11. Observations on reproductive efficiency of "Variegata" in specific areas.
12. Vegetative characteristics of the "Variegata".
13. Variability of floral colouration within the "Variegata".
14. Scoring of characters of reproductive morphology for computing purposes.
15. Previously reported chromosome counts (2n) in tribes and subtribes of the Orchidaceae.
16. Previously reported chromosome counts (2n) in the subtribe Oncidiinae.
17. Previously reported chromosome counts (2n) within the

genus Oncidium sensu Garay & Stacy.

18. Previously reported chromosome counts (2n) within the "Variegata".

19. Chromosome counts (2n) compared to those reported in the literature.

20. Colour behaviour of flavonoid spots.

21. Presence or absence of flavonoid compounds as scored for usage in computer analysis.

22. Morphological characteristics of reference taxa.

23. Numbering of taxa for computer analysis.

LIST OF FIGURES :

1. Orchid drawings with Oncidium variegatum (Sw.) Sw. (bottom right) from Swartz (1800).
2. Braasiella arizajuliana (Withner & Jimenez) Braem et al.
3. Hispaniella henekenii (Schomburgk ex Lindley) Braem.
4. Olgasis gauntlettii (Withner & Jesup) Braem.
5. Olgasis triquetra (Swartz) Rafinesque.
6. Stoloniferous and non-stoloniferous habits of the genus Tolumnia Rafinesque.
7. Tolumnia pulchella (Hooker) Rafinesque.
8. Tolumnia calochila (Cogniaux) Braem.
9. Tolumnia compressicaulis (Withner) Braem.
10. Tolumnia guianensis (Aublet) Braem.
11. Tolumnia haitiensis (Leonard & Ames ex Ames) Braem.
12. Tolumnia leiboldii (Rchb.f.) Braem.
13. Tolumnia lemoniana ssp. guibertiana (A. Rich.) Braem.
14. Tolumnia lucayana (Nash ex Britton & Millspaugh) Braem.
15. Tolumnia prionochila (Kränzlin) Braem.
16. Tolumnia quadrilobia (C. Schweinfurth) Braem.
17. Tolumnia tetrapetala (Jacquin) Braem.
18. Tolumnia tuerckheimii (Cogniaux) Braem.
19. Tolumnia usneoides (Lindley) Braem.
20. Tolumnia variegata (Swartz) Braem.
21. Tolumnia bahamensis (Nash ex Britton & Millspaugh) Braem.
22. Tolumnia hawkesiana (Moir) Braem.
23. Tolumnia sasseri(Moir) Braem.
24. Tolumnia scandens (Moir) Braem.
25. Tolumnia sylvestris (Lindley) Braem.
26. Tolumnia urophylla (Loddiges ex Lindley) Braem.

27. Tolumnia velutina (Lindley ex Paxton) Braem.

28. Tolumnia x osmentii (Withner) Braem.

29. Map of the Caribbean.

30. Map of the Caribbean with distribution of the "Variegata" Oncidiums.

31. Map of the Caribbean with distribution of the genus Braasiella Braem et al.

32. Map of the Caribbean with distribution of the genus Hispaniella Braem.

33. Map of the Caribbean with distribution of the genus Olgasis Rafinesque.

34. Map of the Caribbean with distribution of the genus Tolumnia Rafinesque.

35. Adventitious plantlet at the internode of an inflorescence of Tolumnia prionochila (Kränzlin) Braem.

36. Drawing of the floral structure of Tolumnia calochila (Cogniaux) Braem.

37. Variation in Braasiella arizajuliana (Withner & Jimenez) Braem et al.

38. Variation in Tolumnia pulchella (Hooker) Rafinesque.

39. Variation in Tolumnia tetrapetala (Jacquin) Braem.

40. Variation in Tolumnia variegata (Swartz) Braem.

41. Variation in Tolumnia guianensis (Aublet) Braem.

42. Tolumnia lucayana var.aureum Moir

43. a. Tolumnia tetrapetala (Jacquin) Braem showing a synsepalum.

b. Braasiella arizajuliana (Withner & Jimenez) Braem showing free lateral sepals.

44. Presence of basal callus on the labellum.

45. Variation in the form of the callus in the "Variegata".

46. Floral aspects of Braasiella arizajuliana (Withner & Jimenez) Braem.
47. Tabula Infrastigmatica.
48. Drawing of the typical anther position within the Vandoideae.
49. Different forms of pollinaria within the Orchidaceae.
50. Some forms of pollinaria within the Oncidiinae.
51. Pollinarium of Hispaniella henekenii (Schomburgk ex Lindley) Braem.
52. Pollinarium of Olgasis triquetra (Swartz) Braem.
53. Pollinarium of Tolumnia bahamensis (Nash ex Britton & Millspaugh) Braem.
54. Pollinarium of Tolumnia pulchella (Hooker) Rafinesque.
55. Pollinarium of Tolumnia sasseri (Moir) Braem.
56. Pollinarium of Tolumnia tetrapetala (Jacquin) Braem.
57. Pollinarium of Tolumnia urophylla (Loddiges ex Lindley) Braem.
58. Pollinarium of Tolumnia variegata (Swartz) Braem.
59. Pollinarium of Psychopsis krameriana (Rchb.f.) Jones.
60. Pollinarium of Oncidium spec. (Sect. Cyrtochilum).
61. Pollinarium of Oncidium luridum Lindley (Sect. Plurituberculata).
62. Pollinarium of Oncidium cheirophorum Rchb.f. (Sect. Rostrata).
63. Pollinarium of Oncidium gardneri Lindley (Sect. Crispa).
64. Pollinarium of Oncidium reflexum Lindley (Sect. Oblongata).
65. Pollinarium of Oncidium phalaenopsis Linden & Rchb.f. (Sect. Cucullata).
66. Pollinarium of Oncidium longicornu Mutel

(Sect. Rhinocerotes).

67. Pollinarium of Oncidium gracile Lindley (Sect. Concoloria).

68. Pollinarium of Oncidium pubes Lindley (Sect. Waluewa).

69. Pollinarium of Oncidium sphacelatum Lindley (Sect. Planifolia).

70. Pollinarium of Odontoglossum laeve Lindley.

71. Pollinarium of Brassia sp.

72. Pollinarium of Cochlioda rosea Lindley.

73. Pollinarium of Comparettia macroplectron Rchb.f. & Triana.

74. Pollinarium of Maxillaria porphyrostele Rchb.f.

75. Seed surface structure of Braasiella arizajuliana (Withner & Jimenez) Braem.

76. Seed surface structure of Hispaniella henekenii (Schomburgk ex Lindley) Braem.

77. Seed surface structure of Tolumnia prionochila (Kränzlin) Braem.

78. Seed surface structure of Tolumnia pulchella (Hooker) Rafinesque.

79. Seed surface structure of Tolumnia quadrilobia (C. Schweinfurth) Braem.

80. Seed surface structure of Tolumnia sylvestris (Lindley) Braem.

81. Seed surface structure of Tolumnia tetrapetala (Jacquin) Braem.

82. Seed surface structure of Tolumnia variegata (Swartz) Braem.

83. Seed surface structure of Tolumnia tuerckheimii (Cogniaux) Braem.

84. Seed surface structure of Rodriguezia lehmannii Rchb.f.

85. Seed surface structure of Comparettia falcata Poeppig & Endlicher.

86. Seed surface structure of Ionopsis utricularioides Lindley.

87. Seed surface structure of Psychopsis sanderae (Rolfe) Lückel & Braem.

88. Seed surface structure of Odontoglossum maculatum La Llave & Lexarza.

89. Seed surface structure of Maxillaria picta Hooker.

90. Seed surface structure of Maxillaria picta Hooker.

91. Seed surface structure of Oncidium macropetalum Lindley (Sect. Crispa).

92. Seed surface structure of Oncidium hastatum Lindley (Sect. Stellata).

93. Seed surface structure of Oncidium cheirophorum Rchb.f. (Sect. Rostrata).

94. Seed surface structure of Oncidium pollardii Hagsater (Sect. Rostrata).

95. Frequency of chromosome numbers (2n) in the Orchidaceae.

96. Frequency of chromosome numbers (2n) in the subtribe Oncidiinae.

97. Frequency of chromosome numbers (2n) in the genus Oncidium sensu Garay and Stacy.

98. Chromosome set (2n) of Braasiella arizajuliana.

99. Chromosome set (2n) of Hispaniella henekenii.

100. Chromosome set (2n) of Olgasis gauntlettii.

101. Chromosome set (2n) of Olgasis triquetra.

102. Chromosome set (2n) of Tolumnia bahamensis.

103. Chromosome set (2n) of Tolumnia calochila.

104. Chromosome set (2n) of Tolumnia compressicaulis.

105. Chromosome set (2n) of Tolumnia guianensis.

106. Chromosome set (2n) of Tolumnia guianensis var. alborubrum.

107. Chromosome set (2n) of Tolumnia haitiensis.

108. Chromosome set (2n) of Tolumnia hawkesiana.

109. Chromosome set (2n) of Tolumnia lemoniana ssp. guibertiana.

110. Chromosome set (2n) of Tolumnia lucayana.

111. Chromosome set (2n) of Tolumnia x osmentii.

112. Chromosome set (2n) of Tolumnia prionochila.

113. Chromosome set (2n) of Tolumnia pulchella.

114. Chromosome set (2n) of Tolumnia quadrilobia.

115. Chromosome set (2n) of Tolumnia sasseri.

116. Chromosome set (2n) of Tolumnia scandens.

117. Chromosome set (2n) of Tolumnia sylvestris.

118. Chromosome set (2n) of Tolumnia tetrapetala.

119. Chromosome set (2n) of Tolumnia tuerckheimii.

120. Chromosome set (2n) of Tolumnia urophylla.

121. Chromosome set (2n) of Tolumnia variegata.

122. Chromosome set (2n) of Tolumnia velutina.

123. Location of spots as recognized under UV-light (360nm).

124. Dendrogram of analysis I A.

125. Dendrogram of analysis I B.

126. Dendrogram of analysis I C.

127. Dendrogram of analysis I D.

128. Dendrogram of analysis I E.

129. Dendrogram of analysis II A.

130. Dendrogram of analysis II B.

131. Dendrogram of analysis II C.

132. Tentative evolutionary pattern within the "Variegata".

PRELIMINARY REMARK:

This thesis deals with that group of plants generally known as the "miniature Oncidiums from the Caribbean Islands". These "miniature Oncidiums" differ from all other species put into that genus by their vegetative habit (distichous and generally equitant leaves) as well as by their floral morphology (overall flower morphology, structure of the pollinaria i.a.) and their geographical distribution (only present in the Caribbean). Through a number of taxonomic revisions, these orchids, hitherto considered to be a section of the genus Oncidium, are now separated from that genus and divided into four autonomous genera.

Up to page 63, the species will be known by their previous names, as Oncidium. From the point, where the reclassification is explained, they will be given binominals under their new generic combinations.

Whenever referring to the group as one entity, it will be called informally "Variegata" throughout this thesis.

The intention of this thesis is to study the taxa of the "Variegata" in respect to their interrelationships and to obtain some evidence as to their affinity to some related orchid groups.

1. INTRODUCTION

The Orchidaceae (Jussieu 1789) [1] is one of the largest families of flowering plants. Estimates of the size of the orchid family vary quite widely. Some authors suggest 12,000 to 15,000 species, others as many as 35,000 (Hunt 1967, 1969; Sanford 1977; Dressler 1981), while there is also a very large number of artificially made hybrids.

Such variations in the number of taxa recognized by various authorities as well as the large number of taxa and the ease with which many of them hybridize suggest a rapidly evolving group.

This ease in hybridization also indicates that many taxa, although different in gross morphology, are genetically closely related.

There are about 950 - 1000 orchid species within the Caribbean area (Dressler 1981). Although this is a relatively small number, the orchid flora of this region is extremely interesting and about 30% of these species are endemic to the Caribbean.

Somewhat over 1100 taxa have been described within the genus Oncidium Swartz (see Annex 1). Of these, about 680 can be con-

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(1) This family name was conserved and protected against the earlier published designation Orchideae Hallier (1742), a designation which was used as late as 1883 by Bentham & Hooker. According to the valid rules of botanical nomenclature (ICBN, Voss et al, 1983, Appendix II, page 249) the starting point for the naming of families of Spermatophyta is Jussieu's Genera Plantarum (1789) and the earlier usage of listed names is to be disregarded. Therefore, although the term Orchidaceae was first used by Adanson (1763), the correct citation is Orchidaceae Jussieu 1789.

sidered to be valid species and of these again, 32 are to be found within the Caribbean area, 29 being endemic.
All of these 32 species are epiphytic, inhabiting the different vegetational zones of the islands.
A number of these orchids are known from one single island only.

Although most of these plants have been known for a considerable period of time, little scientific work has been carried out on them. One result of this is that the systematics and taxonomy of the genus Oncidium itself has not been dealt with conclusively.

All of the plants belonging to the group of orchids under discussion here are small-growing and have therefore, up to a few years ago, attracted little attention as they were considered to be without commercial interest.

Some 30 years ago, a few commercial orchid growers in Hawaii started to hybridize these miniature orchids. The result, a group of nice, multicoloured hybrids have by now found their way into many American and European collections.
This boom of "Equitant Oncidium hybrids" as they are generally called in English-speaking regions has also led to an interest in the wild forms that formed their parentage.

One of the most intriguing features of this group of orchids is the large amount of natural hybridization which seems to occur within certain Caribbean islands. This indicates an ac-

tive state of evolution that may well result in the formation of a number of new taxa.

The cultivation of these natural species is however very difficult as it is nearly impossible to imitate the climatic details of their natural environment in the greenhouse.

These intriguing plants do however deserve a closer scientific examination. Difficulties in obtaining plant material did not hinder my wish to attempt a modern revision of the group.

As will be seen from the following discussion, I have attempted as much objectivity as possible by choosing different methods available to the taxonomist. However, due to the nature of the work, complete objectivity will never be achieved in a systematic revision of any group of plants.

2. CLASSIFICATION OF THE FAMILY ORCHIDACEAE Jussieu.

A Brief History

The Orchids probably form the largest family of the flowering plants (Willis 1973) ranking in front of the Asteraceae, followed by the Fabaceae and the Poaceae.

Taxonomically, they are also one of the most unstable groups. The development of a higher classification for these plants has involved the repeated and continued reshuffling of a small group of anther- and pollen characteristics.
Efforts to introduce new criteria into the system have been attempted, but very few of these attempts have been successful.

Orchids were described by the Chinese as early as 550 BC. In Europe, the oldest reports go back to Theophrastus of Lesbos (ca. 372 - ca. 287 B.C.) who, in his Historia plantarum, part 9, treated a number of plants under the name Orchis (Lehane 1977). They were repeatedly mentioned in medieval herbals and the testiculate tuberoid organs of the European species were often erroneously considered to be an aphrodisiac.
The beginning of modern orchidology dates back to Linnaeus. In Species Plantarum (Linnaeus 1753) he included under CLASSIS XX, GYNANDRIA, Diandria, 8 genera of orchids with a total of 62 species. The second edition of his work already included 102 species and varieties of orchids. Few of his original taxa have however remained unaltered to this day.

Jussieu (1789) listed the orchid family as Orchidaceae, a name which he apparently based on Adanson's Familles des Plantes (1763). His nomenclature of families was adopted by the Committee for Spermatophyta and therefore listed under NOMINA FAMILIARUM CONSERVANDA (Voss et al. 1983).

The first botanist who can claim the title of orchidologist was most probably Olof Swartz. He was the first to distinguish between orchids with one anther and those with two (Swartz 1800), and he divided the Orchidaceae into Monandrae and Diandrae accordingly (table 1).

This distinction is still of undoubted importance and some modern botanists have indicated that the Orchidaceae could be separated into two families on the bases of the number of fertile anthers.

Table 1 : System of the Orchidaceae as published by O. Swartz (1800).
Photocopied from the original.

ORCHIDEÆ.

- **Monandræ.**
  - Anthera ſubterminali, ſtylo breviſſimo connata; Calcare floris
    - Postico; *Calyce*
      - reſupinato; galea unicalcarata ... Diſa.
      - ringente; galea bicalcarata ... Satyrium.
    - Nullo; *Calyce*
      - foliolis lateral. exterior. horizontalibus concavis ... Pterygodium.
      - foliolis lateralibus exterior. horizontalibus calcaratis ... Disperis.
      - 4-phyllo, foliolis lateralibus erectis, baſi ventricoſis ... Corycium.
      - foliolis omnibus ſubpatentibus ... Ophrys.
      - foliolis omnibus conniventibus ... Serapias.
  - Anthera erecta ſtylo parallela, lateri ejus poſtico adfixa.
    - *Calyce*
      - foliolis lateralibus baſi antice productis ... Neottia.
      - reſupinato; labello galeato ... Cranichis.
      - patente; labello foliol. *calyc.* conformi ... Thelymitra.
      - 7-phyllo; foliolis 2 anter. elongatis labello ſuppoſitis ... Diuris.
    - perſiſtente; *polline* granuloſo; *Calyce*
      - ſubringente ... Arethuſa.
      - ſubpatente ... Epipactis.
  - Anthera operculari, margini poſtico apicis ſtyli inſerta, mobili,
    - plerumque decidua; *polline* globulari; *Calyce*
      - reſupinato; labello adſcendente ... Malaxis.
      - labello concavo ... Cymbidium.
      - labello plano ... Oncidium.
      - labello erecto, inferne ſtylo connexo ... Epidendrum.
      - labello ſubcucullato; capſula ecarinata ... Vanilla.
    - plerumque decidua; *polline* globulari; patente
      - labello lamina ſaccata ... Aërides.
      - labello baſi calcarato ... Limodorum.
      - labello a foliol. *calyc.* anter. baſi productis incluſo ... Dendrobium.
      - labello foliol. *cal.* conformi; exterioribus baſi coalitis ... Stelis.
      - labello nullo ... Lepantes.

Diandrum ——— Cypripedium.

A few years later, Robert Brown made some very substantial advances in orchid taxonomy (Brown 1810). His system for the orchids, was based almost entirely on features of the pollen and the anther.

The criteria Brown used to construct his classification have persisted to this day and even 170 years after Brown's publication, it is difficult to fault his use of attributes as a means of describing the anther and the pollinia.

The next noteworthy attempt to subdivide the orchid family was performed by John Lindley. In his Orchidearum Sceletos published in London in the year 1826, he recognized 8 tribes. This system was later revised to 7 tribes with "sections" and "divisions" in some of them.

The Genera and Species of Orchidaceous Plants (Lindley 1830 - 1840) was published in several parts. This work is a classic of the science. Lindley described all 1980 orchid species known to him at that time and arranged them into a system which he explained in his first chapter (table 2).

Lindley also gave prominence to the male reproductive parts and claimed that:

> "In classifying this order, the most important characters appear to reside in the pollen."

Table 2 : System of the Orchidaceae according to Lindley

1. One Anther.

A. Pollen masses waxy

a. No caudicular or separable stigmatic gland. Tribe I. MALAXEAE

b. A distinct caudicula, but no separate stigmatic gland. Tribe II. EPIDENDREAE

c. A distinct caudicula united to a deciduous stigmatic gland. Tribe III. VANDEAE

B. Pollen powdery, granular or sectile

a. Anther terminal, erect. Tribe IV. OPHREAE

b. Anther terminal, opercular. Tribe V. ARETHUSEAE

c. Anther dorsal Tribe VI. NEOTTEAE

2. Anthers two Tribe VII. CYPRIPEDEAE

Like Swartz, Lindley made an initial distinction between plants with one anther and those with two. Furthermore, he achieved another milestone by using the term "tribe" to describe his proposed subdivisions and by naming each of them.

The next major botanist to be considered is George Bentham who modified Lindley's system for use in his Genera Plantarum (1862 - 1883) which he published together with J. D. Hooker. They recognized only 5 tribes and subdivided them into a total of 27 subtribes.

H. G. Reichenbach was one of the most active orchidologists of the nineteenth century. He made an important contribution to orchid taxonomy by promoting the use of pollinia for classification (Reichenbach 1852). The problem of the taxonomy at the level of subfamilies and tribes was, however, of little concern to him. Although he reviewed orchid classification in 1884, the importance of that work is not to be overrated. In contrast to Lindley who did not consider phylogeny in defining his system, Reichenbach's system was hierarchic with groups that were themselves divided into subgroups. The names of the groups however were inconsistent with earlier work and Reichenbach's intentions were often rather unclear. Reichenbach mostly worked on the level of genera and species. He was quite arbitrary and capricious, often forgetting what he himself had done a short time before and changing from one extreme of opinion to another within a short time. His descriptions were often too brief to carry much information, resulting in serious difficulties for all orchidologists after

him.

Later he became angry over the fact that some other people not only worked on orchids but questioned his judgment as well. Although he is supposed to have promised his herbarium to Kew on several occasions, his Will specified that his collection would go to whichever institution willing to keep it locked in its vaults for 25 years. Thus Reichenbach's substantial collection ended up at the Museum of Natural History in Vienna and remained unavailable for 25 years after his death.

Ernest Pfitzer, a German botanist, criticized the system of Bentham and Hooker (Pfitzer 1887) and offered a new system primarily based on vegetative features, which resulted in a highly artificial classification.

Perhaps the least useful of all orchid-revisors was Beer (1863) who classified all orchids into 5 "Sippen" which were based merely on flower shape. Beer, for example, threw Angraecum Bory and Habenaria Willdenow (one fertile anther) and Cypripedium Linné (two fertile anthers) together.

Another bad example of orchid taxonomy resulted from Kränzlin (1910 - 1928) who revised the Orchidaceae on the basis of the Reichenbach Herbarium. Although he was a student of Reichenbach, his many "revisions" were of uniformly low quality. Many of his new species were described in the wrong genera, adding to the confusion left behind by Reichenbach's curious legacy.

The next system worth discussing is that of Rudolf Schlechter,

a German botanist working in Berlin. In 1915 [1] Schlechter published a book entitled Die Orchideen in which he made considerable additions to the Pfitzer system. The second edition of the book, edited by Miethe and published 1927, two years after Rudolf Schlechter's untimely death, included Schlechter's system as published in the 1914 edition. In the meantime however, Mansfeld had completed and published (Schlechter 1926) an unfinished manuscript found among Schlechter's papers entitled Das System der Orchideen in which Schlechter revised his system considerably on the basis of his extensive field work. Indeed, more than any of his predecessors, Schlechter had the opportunity to study plants in the field and no-one before or since, has contributed so many new taxa to the orchid family. Although definitely based on Pfitzer's work, Schlechter's system is more modern and comprehensive with 610 listed genera.

Schlechter's system was the most popular for several decades. It was revised several times by Mansfeld (1937a, 1937b, 1954). Dressler and Dodson (1960) modified it, largely to bring it into accordance with the valid Rules of Botanical Nomenclature. Brieger, in the third edition of Schlechter's Die Orchideen (1973) revised the system again, recognizing 5 subfamilies divided into a total of 18 tribes.

Another recent attempt to set up a system for the Orchidaceae was made by Garay (1972, 1974, 1977) who suggested the diver-

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(1) This book is often erroneously cited as being published in 1914, the error probably arising from the fact that the foreword written by Rudolf Schlechter is dated "in Dezember 1914".

sification of the family into 5 subfamilies (not identical with those of Brieger).

The latest attempt to bring the orchids into a natural system was made by Robert L. Dressler (1981) whose system is divided into 6 subfamilies with a total of 19 tribes and additionally 2 anomalous tribes placed between the subfamilies Orchidoideae Dressler and Epidendroideae Lindley.
Dressler considers seed coat morphology and pollinium structure as major systematic criteria within the family and its divisions. New evidence, especially in the field of seed coat morphology as examined under the Scanning Electron Microscope has shown, that Dressler's concept as published in 1981 already needs to be revised (Dressler, in litt.).

Table 3 : Comparison of the major systems of orchid classification (after Dressler 1981).

Lindley	Schlechter	Garay	Dressler
Family Apostasiaceae	Family Apostasiaceae	Family Orchidaceae Subfamily Apostasioideae	Family Orchidaceae Subfamily Apostasioideae
Family Orchidaceae Tribe Cypripedieae	Family Orchidaceae Subfamily Diandrae	Subfamily Cypripedioideae	Subfamily Cypripedioideae
	Subfamily Monandrae	Subfamily Orchidoideae	Subfamily Orchidoideae
Tribe Ophrydeae	Tribe Ophrydeae	Tribe Orchideae	Tribe Orchideae Tribe Diseae
		Subfamily Neottioideae	
Tribe Neottieae	Tribe Polychondreae	Tribe Neottieae	Tribe Neottieae Tribe Diurideae
		Tribe Cranichideae	Subfamily Spiranthoideae
		Tribe Epipogieae	Subfamily Epidendroideae Tribe Epipogieae Tribe Vanilleae Tribe Gastrodieae
Tribe Arethuseae			Tribe Arethuseae
		Subfamily Epidendroideae	Tribe Coelogyneae
Tribe Epidendreae	Tribe Kerosphaereae	Tribe Epidendreae	Tribe Epidendreae
Tribe Malaxideae			Tribe Malaxieae
Tribe Vandeae		Tribe Vandeae	Subfamily Vandoideae Tribe Polystachyeae Tribe Vandeae Tribe Maxillarieae Tribe Cymbidieae

3. THE GENUS ONCIDIUM Swartz

3. 1. GENERAL REMARKS

The genus Oncidium was defined by Olof Swartz and based on the following 5 species (Swartz 1800)

1) Oncidium "chartaginense" (sic), correctly Oncidium carthagenense, originally described as Epidendrum carthagenense by Jacquin (1760),

2) Oncidium altissimum, originally described as Epidendrum altissimum by Jacquin (1760),

3) Oncidium quadripetalum, originally described as Epidendrum tetrapetalum [1] by Jacquin (1760),

4) Oncidium variegatum, originally described as Epidendrum variegatum by Swartz (1788)

5) Oncidium cebolleta, originally described as Epidendrum cebolleta by Jacquin (1760).

Of these, only Oncidium variegatum (Sw.) Sw. was illustrated in the publication (cfr. Swartz 1800, Tab. III).

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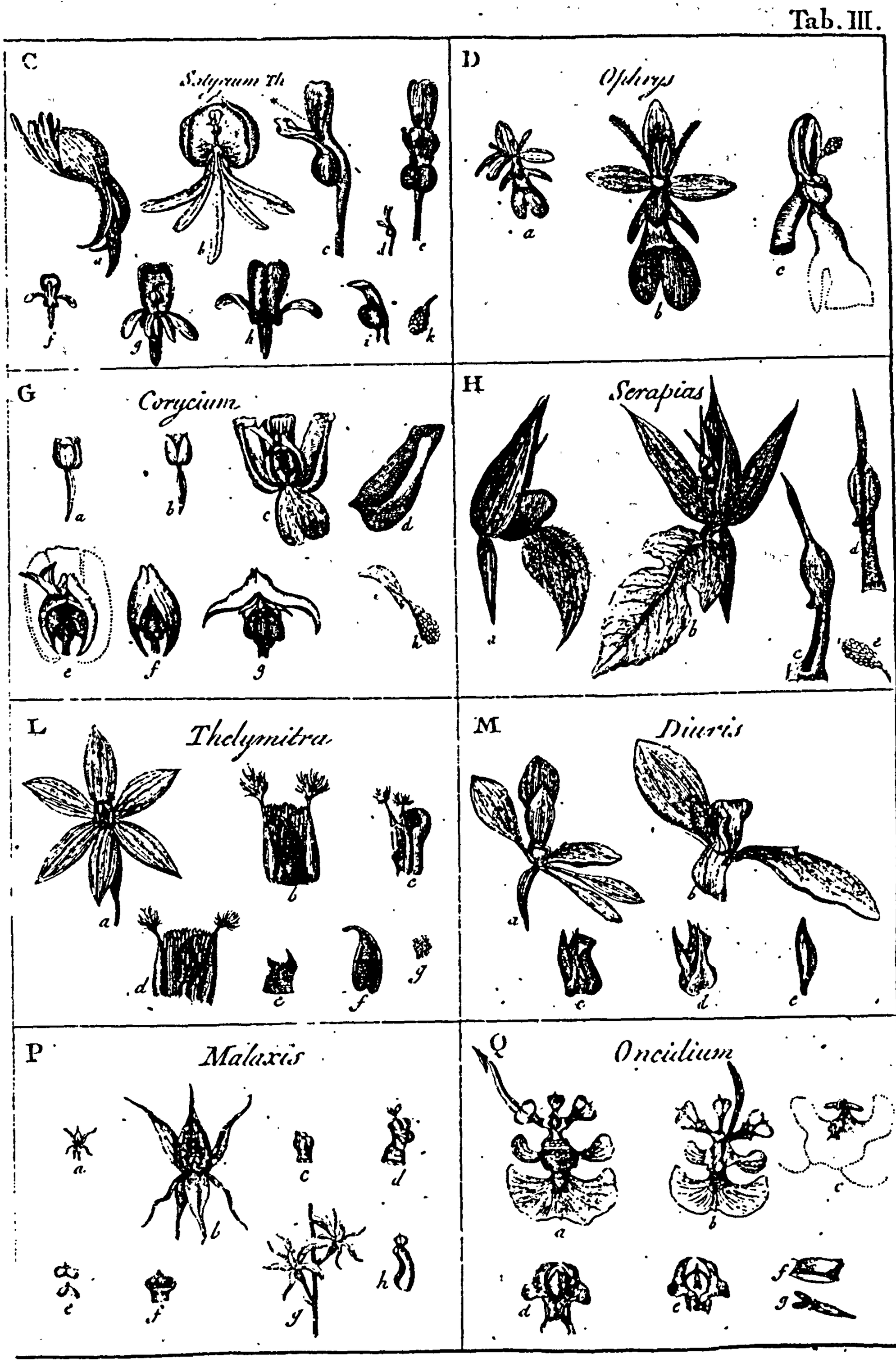
(1) Swartz probably considered it advisable to translate the Greek prefix "tetra" into the latin form "quadri". The Rules of Botanical Nomenclature however, do not provide for such "corrections".

Figure 1 : Orchid drawings with Oncidium variegatum (Sw.) Sw. (bottom right) from Swartz (1800).



At the time of the generic description, the criteria used by Swartz were satisfactory for separation of the genus from others. Over the years however, many new orchids have been discovered and described. All those fitting somewhat within the criteria given by Swartz ended up in Oncidium. Oncidium thus became the "mammut genus" with over 1100 taxa described (Annex I).

The genus Oncidium was characterized primarily by its free calyx, a flat labellum with a basal callus and a column with an operculate, deciduous anther (2)
The genus finds its place within the subfamily Vandoideae Endlicher (1841) because of the lateral inflorescence, an anther with reduced partitions, superimposed pollinia and the presence of a viscidium and a stipe.

(2) Translated from the original latin description of Swartz.

Table 4 : Description of the genus Oncidium by Swartz (1800).
(Photocopy of the Original)

17. ONCIDIUM S. Tab. III. Q.

Char. eſſent. Calyx patens.
Labellum planum, baſi tuberculoſum.
Anthera opercularis, decidua.

Character naturalis.

Calyx 4-5-phyllus:
Foliola patentia, ſubungviculata; tria *exteriora*: duo *interiora* majora, plana, ſubrepanda; ſ. duo exteriora, duo interiora (ſi calyx 4-phyllus.)
Cor. Labellum e baſi ſtyli, patens, lobatum, lobo medio magno, diſco ſuperne gibbis duobus elevatis.
Genit. Stylus e *Germine* infero, ſubtereti, lineari erectus, antice excavatus, marginibus apicis alatis.
Anthera ſubrotunda, opercularis inter alulis apicis ſtyli, bilocularis, decidua.
Maſſæ Pollinis globulares, binæ, pedicello communi junctæ.
Stigma infra antheram, concavum.
Per. præcedentium.

Q 3 *Anm.*

240 *1800, Jul. Aug. Sept.*

Anm. Slägtet ſom har ſit namn af Ογκιδιον, *Tuberculum*, i afſeende på *Labelli* beſkaffenhet, utmärker ſig utom med blommań, genom ſin näſlan ſom en blomvippa ofvantil fördelte blomſtani, hvilken är af hårdare och icke ſå örtlik natur ſom vanligen andre Orchiders.

Species.

Oncidium chartaginenſe.
Epidendrum *Jacq.*
altiſimum.
Epidendrum *Jacq.*
quadripetalum.
Epidendrum *Jacq.*
variegatum.
Cymbidium Flor. Ind. occid.
Cebolleta.
Epidendrum *Jacq.*

The genus Oncidium Swartz is one of the largest genera within the subfamily Vandoideae Endlicher.

Within the systematic scheme of Dressler (1981), the genus, consisting of about 680 species has its place within the tribe Cymbidiae Pfitzer, subtribe Oncidiinae Bentham (see table 5).

The genus is widely distributed throughout the tropical and subtropical regions of the American continent from Florida to Argentina through Mexico, Guatemala, Honduras, San Salvador, Costa Rica, Panama, Venezuela, The Guianas, Columbia, Bolivia, Peru, Ecuador and Brazil and most of the Caribbean Islands as well as Trinidad and Tobago.

Most species of this genus grow epiphytically in highly humid conditions in tropical and subtropical forests, but some are adapted to relatively or even strongly arid areas.

The genus exhibits wide variations in external morphology in many characters, and includes various types of habits. Within the genus, there is also a wide variation in chromosome numbers, and very few natural intrageneric hybrids are known, indicating that the species of the genus do not cross freely in natural conditions.

The taxonomy of this genus is very difficult because the criteria for species classification as well as the limits of the genus are not well understood.

Table 5 : Position of the genus Oncidium Swartz in Dressler's system (1981).

Family : ORCHIDACEAE Jussieu

Subfamily: VANDOIDEAE Endlicher

This subfamily is characterized by lateral inflorescences, an anther with reduced partitions, superposed pollinia and the presence of a viscidium and a stipe.

Tribe : CYMBIDIAE Pfitzer

Dressler divided the "vandoid orchids" with two pollinia into the Tribes Vandeae Lindley and Cymbidiae Pfitzer. In the first of these, he put all those genera which are without exception monopodial. The remaining genera were put in the latter tribe.

Subtribe : ONCIDIINAE Bentham

Epiphytic or terrestrial plants with pseudobulbs out of a single internode, usually dipodial. sometimes monopodial, with distichous, duplicate, mostly articulated, cylindrical or flattened leaves, simple or branched inflorescence and one to numerous, generally resupinated, tiny to medium sized flowers. The labellum may be spurred or may have basal nectariferous appendages.

Genus : ONCIDIUM Swartz

Dressler, and all the authors before him, have considered the subtribe Oncidiinae Bentham as a complex group of orchids and few authors have ventured to take a closer look at these plants.

The present work certainly is but a small piece within the greater building of our Science, but it proves that much still remains to be done on many different levels.

3. 2. REVISIONS OF THE GENUS ONCIDIUM Swartz.

3. 2. 1. SURVEY AND TYPIFICATION.

There have been two revisions of the genus. The first was by Fritz Kränzlin, published in Engler & Prantl's Das Pflanzenreich (Kränzlin 1922). That work is generally considered to be quite inaccurate and most unsatisfactory for the identification of species.
Indeed, all those having worked with Kränzlin's treatment of the Oncidiinae, know that it is rather more confusing than helpful.

For nearly 50 years subsequently, no one worked on the genus taxonomically, and whatever "looked like an Oncidium" was simply put into the genus.

The second revision of the genus arose out of Garay's frustration in working with Kränzlin's monograph. Garay (1970) wrote:

> "I attempted to use the monograph of the genus Oncidium by Kränzlin,... . One of the obvious shortcomings of this work is that many of the illustrations, although designed to facilitate correct identification, have no resemblance to the details provided in the description of the corresponding species. Consequently, since 1922, when this monograph was published, this book has been the source of numerous errors and the cause of many wrong identifications."

Garay's frustration resulted in his Reappraisal of the Genus Oncidium, a paper which he intended for use "in conjunction with Kränzlin's monograph" (Garay 1970).

"It must be emphasized that this study is not a new revision of the genus Oncidium, but a reappraisal of it within the framework established by Kränzlin. Therefore, this paper has to be read and used in conjunction with Kränzlin's monograph."

Garay corrected some of Kränzlin's taxonomic and nomenclatural errors and reincluded some parts which were separated from Oncidium Swartz by Kränzlin such as the genus Cyrtochilum HBK.

Garay chose Oncidium variegatum (Sw.) Sw., one of the Caribbean species, as the lectotype of the genus. This was criticized by Williams & Dressler (1973) who considered Oncidium altissimum (Jacq.) Sw. as the valid type species as proposed by Pfeiffer (1874).

Garay's reappraisal is nothing more than a listing of those species which he considered to belong in the genus. It was of relatively little use, especially as it proved to be rather superficial.

Realizing this himself, Garay wrote, together with Stacy, (1974) a Synopsis of the Genus Oncidium in which they reviewed the genus section by section, and in which Garay's choice of Oncidium variegatum (Sw.) Sw. as type species was defended as follows:

"Garay chose Oncidium variegatum (Sw.) Sw. of the five specific epiphets listed by Swartz, because it was illustrated by Swartz, and because in the original generic description certain characters apply only to Oncidium variegatum...".

This was an obvious misinterpretation of the text of Swartz's generic diagnosis as all those characters listed which were applying to Oncidium variegatum also apply to Oncidium tetra-

petalum (listed by Swartz as Oncidium quadripetalum). In fact the arguments of Garay and Stacy can be reduced to the following three points:

1. Oncidium variegatum is the only species of the genus illustrated by Swartz in his original publication of the genus Oncidium (Swartz 1800.).

2. Oncidium altissimum (Jacq.) Sw. has been misinterpreted and should be considered to be the valid name for the plant hitherto known as Oncidium luridum Lindley.

3. Pfeiffer never intended to typify any genus in the sense of typification outlined in the Code.

The criticism however, was continued by Brieger (1975b) and Dressler & Williams (1975a) and the latter two authors made a proposal to reject Garay's choice and to conserve the generic name Oncidium with the lectotype Oncidium altissimum (Jacq.) Sw. (Dressler & Williams 1975b).

The proposal of Dressler & Williams was rejected by the Committee for Spermatophyta by a 7-5 vote in 1978 (Stafleu 1978), and the choice of Garay had to be accepted. Dressler and Williams however renewed their proposal (Dressler & Williams, 1982), and this new proposal was dealt with in 1985. This time, the Committee for Spermatophyta ruled against Garay, and with a 10-2 vote, reinstated Oncidium altissimum (Jacq.) Sw. as type species for the genus Oncidium (Stafleu 1985).

All authors working on Oncidium agree that the genus has to be completely reconsidered. Although several comprehensive studies have been announced since Garay's synopsis was published, none has as yet been completed. Merely some single species or small group of species have been separated as autonomous genera. (Kränzlin 1922, Garay and Stacy 1974, Dodson & Dressler 1972, Braem 1980b., Lückel & Braem 1982.)

3. 2. 2. ONCIDIUM SECTION ONCIDIUM.

3. 2. 2. 1. GARAY AND STACY'S CONCEPT.

In their Synopsis of the Genus Oncidium, Garay and Stacy (1974) recognized and reidentified 26 sections. According to Article 22 of the International Code of Botanical Nomenclature the section including the type species was named section Oncidium.

The section Oncidium was defined as follows (Garay & Stacy 1974):

" Oncidium section Oncidium

Lectotype: Epidendrum variegatum Sw.

Syn.: Genus Olgasis Raf., Fl. Tellur. 2: 51 (1837)
Type: Cymbidium triquetrum Sw.

Genus Tolumnia Raf., Fl. Tellur. 2: 101 (1837)
Type: Oncidium pulchellum Hook.

Genus Xaritonia Raf., Fl. Tellur. 4: 9 (1838)
Type: Epidendrum tetrapetalum Jacq.

Oncidium sect. Equitantia Lindl. in Paxt., Fl. Gard. 1: 24 (1850)
Lectotype: Epidendrum variegatum Sw., in hoc loco.

Oncidium sect. Olgasis (Raf.) O. Ktze. in Post & Ktze., Lex. Gen. Phan. 399 (1903)
Type: Cymbidium triquetrum Sw.

Oncidium sect. Tolumnia (Raf.) O. Ktze. in Post & Ktze., Lex. Gen. Phan. 399 (1903)
Type: Oncidium pulchellum Sw. (sic)

Oncidium sect. Aphanobulbia-Variegata Krzl. in Pflanzenr. Heft 80: 96 (1922)
Lectotype: Epidendrum variegatum Sw., in hoc loco.

Sepals more or less fleshy. Petals and lip, excluding callosities, membranaceous. Pseudobulbs inconspicuous, poorly developed with a terminal, aborted appendage in lieu of a developed leaf. Lateral sheaths all leaf-bearing, distichous. Leaves triquetrous with finely serrate edge ".

Table 6 : Taxa included in Oncidium section Oncidium by Garay and Stacy (1974).

1. Oncidium apiculatum Moir (1968)
2. Oncidium arizajulianum Withner & Jimenez (1967)
3. Oncidium bahamense Nash ex Britt. & Millsp. (1920)
4. Oncidium berenyce Rchb.f. (1862)
5. Oncidium calochilum Cogn. (1910)
6. Oncidium caribense Moir (1973)
7. Oncidium caymanense Moir (1968)
8. Oncidium compressicaulis Withner (1966)
9. Oncidium concavum Moir (1968)
10. Oncidium cuneilabium Moir (1968)
11. Oncidium gauntlettii Withner & Jesup (1964)
12. Oncidium guianense (Aubl.) Garay (1973)
13. Oncidium quibertianum A. Richard (1850)
14. Oncidium haitiense Leonard & Ames ex Ames 1922
15. Oncidium hawkesianum Moir (1967)
16. Oncidium henekenii Schomburgk ex Lindl. (1855)
17. Oncidium jimenezii Moir (1972)
18. Oncidium leiboldii Rchb.f. (1863)
19. Oncidium lemoniamum Lindl. (1835)
20. Oncidium lucayanum Nash ex Britt. & Millsp. (1920)
21. Oncidium lyratum Withner (1967)
22. Oncidium moirianum Osment (1972)
23. Oncidium osmentii Withner (1967)
24. Oncidium prionochilum Krzl. (1922)
25. Oncidium pulchellum Hook. (1827)
26. Oncidium scandens Moir (1968)
27. Oncidium sylvestre Lindl. (1858)

28. Oncidium tenellum Gerard (1847)

29. Oncidium tetrapetalum (Jacq.) Willd. (1806)

30. Oncidium triquetrum (Sw.) R. Br. (1813)

31. Oncidium tuerckheimii Cogn. (1912)

32. Oncidium urophyllum Loddiges ex Lindl. (1842)

33. Oncidium usneoides Lindl. (1858)

34. Oncidium variegatum (Sw.) Sw. (1800)

35. Oncidium velutinum Lindl. ex Paxt. (1851)

Oncidium quadrilobium, described by C. Schweinfurth (1946) was made synonymous with Oncidium leiboldii Rchb.f.

4. REVISION OF ONCIDIUM SECTION ONCIDIUM Garay.

4. 1. HERBARIUM WORK AND LITERATURE SEARCH.

4. 1. 1. HERBARIUM WORK.

I had the opportunity of visiting the herbaria of Kew (K), Edinburgh (E), Vienna (W), Brussels (BR) and of the Institute of Jamaica, Kingston/Jamaica.
Material was also sent to me on loan from the herbaria in Utrecht (U), Paris (P) and Copenhagen (C).

The most important collections of the genus Oncidium Swartz are without any doubt to be found in the herbarium at Kew and in the Reichenbach Herbarium in Vienna, and both collections were consulted on several occasions.
The Herbaria in Edinburgh, Paris, Brussels, Utrecht and Copenhagen have very few (5 - 20) sheets, partly representing duplicates from Kew or Vienna.
The herbarium in Harvard was contacted as W. W. G. Moir claimed to have sent the types there of those taxa described by him. Dr. Leslie A. Garay, the curator of the Oakes Ames Herbarium however informed me (Garay in letter) that no such material was ever received.

Several other herbaria were contacted. Some did not respond, others informed me that no material was lent and that no reproductions could be send because of lack of personnel.

The herbarium of the Institute of Jamaica in Kingston, Jamaica

keeps about 30 specimens of Jamaican taxa of the section. They did not reveal any new aspects in comparison to my studies at Kew and in Vienna. The herbarium of Edinburgh has but few specimens concerning this group of orchids, none of them revealing any aspects which could be useful to this study.
In Brussels some specimens can be found in the remains of the Cogniaux Herbarium. This collection also did not offer any new aspects to this study.

4. 1. 2. LITERATURE SEARCH

After having searched for and collected all pertinent literature, I found the following described taxa to belong in the group of orchids called Oncidium Section Oncidium by Garay and Stacy (1974). Eleven taxa were not considered by those authors. They are marked with (!) in the following table. These have all the characters mentioned by these authors, and must be placed in this group, whatever its correct status, on their criteria and my judgement.

Table 7 : Taxa belonging to Oncidium section Oncidium as found in the literature.

(Those taxa not included in the listing of Garay & Stacy in their work of 1974 are marked with (!).)

1. Oncidium apiculatum Moir (1968)
2. Oncidium arizajulianum Withner & Jimenez (1967)
3. Oncidium bahamense Nash ex Britton & Millspaugh (1920)
4. Oncidium berenyce Rchb.f. (1862)
5. Oncidium calochilum Cogniaux (1910)
6. Oncidium caribense Moir (1973)
7. Oncidium caymanense Moir (1968)
8. Oncidium compressicaulis Withner (1966)
9. Oncidium concavum Moir (1968)
10. Oncidium cuneilabium Moir (1968)
11. Oncidium desertorum Nash ex Withner (1967) (!)
12. Oncidium dubium E. André (1873) (!)
13. Oncidium gauntlettii Withner & Jesup (1964)
14. Oncidium guianense (Aubl.) Garay (1973)
15. Oncidium guibertianum A. Rich. (1850)
16. Oncidium guttatum Fawcett & Rendle (1910) (!)
17. Oncidium haitiense Leonard & Ames ex Ames (1922)
19. Oncidium hawkesianum Moir (1967)
19. Oncidium henekenii Schomburgk ex Lindley (1855)
20. Oncidium jimenezii Moir (1972)
21. Oncidium intermedium Bertero ex Sprengler (1826) (!)
22. Oncidium leiboldii Rchb.f. (1861)
23. Oncidium lemonianum Lindley (1835)
24. Oncidium lucayanum Nash ex Britton & Millspaugh (1920)
25. Oncidium lyratum Withner (1967)
26. Oncidium moirianum Osment (1973)

27. Oncidium osmentii Withner (1967)

28. Oncidium prionochilum Kränzlin (1922)

29. Oncidium pauciflorum Lindley (1821) (!)

30. Oncidium pulchellum Hooker (1827)

31. Oncidium pulchellum Bello (1883) (!)

32. Oncidium quadrilobium C. Schweinf. (1946) (!)

33. Oncidium quadripetalum Swartz (1800) (!)

34. Oncidium sasseri Moir (1975) (!)

35. Oncidium scandens Moir (1968)

36. Oncidium sylvestre Lindley (1858)

37. Oncidium tenellum Gerard (1847)

38. Oncidium tetrapetalum Griseb. (1864) (!)

39. Oncidium tetrapetalum (Jacq.) Willd. (1805)

40. Oncidium tricolor Hooker (1844) (!)

41. Oncidium triquetrum (Swartz) R. Brown (1813)

42. Oncidium tuerckheimii Cogniaux (1912)

43. Oncidium urophyllum Loddiges ex Lindley (1842)

44. Oncidium usneoides Lindley (1858)

45. Oncidium variegatum (Swartz) Swartz (1800)

46. Oncidium velutinum Lindley ex Paxton (1851)

4. 1. 3. CONCLUSIONS

The review of the available herbarium material and a careful study of all available literature on the subject resulted in the following conclusions:

Oncidium apiculatum (Moir 1968) [1] and Oncidium cuneilabium (Moir 1968) are two concepts based on single plants collected and sent to Moir from Jamaica in 1959. Both taxa as described by Moir and illustrated in his booklet (Moir & Moir 1970) are easily to be recognized as Oncidium tetrapetalum (Jacquin) Willdenow.

Oncidium berenyce Rchb.f. is known only from Reichenbach's description (Reichenbach 1962) and a single herbarium sheet in his collection deposited in Vienna (Herb. Mus. Palat. Vindob.,Reichenbach: Herb. Orchid. No. 25253).
The sheet consists of an inflorescence with 4 flowers and a single flower attached separately. A study of the herbarium material and Reichenbach's description have convinced me that Oncidium berenyce Rchb.f. is to be considered synonymous with the earlier published Oncidium tetrapetalum (Jacq.) Willd.

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(1) A considerable amount of the recent literature on the "Variegata" was published by the Hawaiian orchid amateur W. W. G. Moir. Moir deserves a lot of credit for his work as a breeder of orchid hybrids.
His taxonomic work however, is difficult to follow and cannot always be taken seriously, the main problem being that he rejects any scientific approach to studies with living material. Although some of his publications comply with the rules of nomenclature, his information is often erroneous and misleading.

"Oncidium caribense (Moir 1973) cannot be recognised as a valid species. The publications and illustrations therein concerning this taxon (?) (Moir 1973, Moir & Moir 1980, Withner 1980) are contradictory."

Oncidium caymanense (Moir 1968) is most probably a variety of Oncidium leiboldii Rchb.f., and here again, description and other publications (Moir 1968, Withner 1980) are contradictory.

Oncidium concavum (Moir 1968) is without any doubt a variant of Oncidium pulchellum Hooker which grows in cooler, higher localities than the type (Braem 1983b).

Oncidium dubium (Ed. André 1873) is identical with Oncidium triquetrum (Sw.) R. Brown. as is easily recognized by the description and the accompanying drawing.

Oncidium guianense (Aubl.) Garay was originally described as Ophrys guianensis by Aublet (1775), based on " Helleborine foliis carnosis, carinatis & falcatis" of Plumier (1703, 1759). The same species was described by Poiret (1798) as Ophrys aloidea, as Oncidium intermedium Bertero, published by Sprengler in 1826 and as Oncidium desertorum by Nash, a concept which was published by Withner in 1967. Oncidium guianense is the valid name.

Oncidium guibertianum A. Richard (1850) has semi-terete leaves. The flowers prove, in all aspects, identical to those of Oncidium lemonianum Lindley (1835). The study of all herbarium material of both taxa, the descriptions of Achille Richard and John Lindley allow for no other conclusion than that Oncidium

guibertianum A. Richard and Oncidium lemonianum Lindley are geographical variants of one single species, correctly known (priority) as Oncidium lemonianum (see p. 77).

Literature and herbarium studies indicate that Oncidium hawkesianum (Moir 1967) could be identical with Oncidium sylvestre Lindley.

Oncidium jimenezii is another species known only from the description by W. W. G. Moir in 1972. On the basis of that description, I suggest that Oncidium jimenezii Moir is identical with Oncidium x ann-hadderae Moir (Moir 1972), a natural hybrid between Oncidium haitiense Nash ex Britton & Millspaugh and Oncidium variegatum (Sw.) Sw.

Oncidium lyratum (Withner 1967c) also is known only from the original description. Withner described the species on the basis of two herbarium specimens, one collected by Britton, Britton and Wilson in 1916, deposited at the New York Botanical Garden, and another collected in 1959 by W. Stimson deposited at the Oakes Ames Herbarium at Harvard. Both collections are indicated to originate from the Cuban Isle of Pines. The older specimen was deposited under the name of Oncidium intermedium and described by the collectors as having white and purple flowers, one plant having flowers with a red lip. The Stimson specimen was described by the collector as having dark reddish-orange flowers with a strongly reddish-orange lip.

To say the least, Withner's description of Oncidium lyratum is not at all conclusive. Unfortunately, neither the New York Botanical Gardens nor the Oakes Ames Herbarium were prepared to lend the specimens or send reproductions of the herbarium sheets.

I suggest that Oncidium lyratum Withner is a geographical variant of the extremely variable Oncidium lucayanum Nash ex Britton & Millspaugh.

William Osment, a commercial collector from USA described a Oncidium moirianum (Osment 1972). His description is contradictory to those of Moir & Moir (1980) and Withner (1980). According to the original description and the accompanying illustration, I am convinced that Oncidium moirianum Osment is identical with Oncidium lucayanum Nash ex Britton & Millspaugh.

Oncidium osmentii (Withner 1967) was redescribed as Oncidium x osmentii (Moir 1972). This plant is a natural hybrid between Oncidium haitiense Leonard & Ames ex Ames and Oncidium quadrilobium C. Schweinfurth as was proven by the experimental crossing of the two species by Moir.

The concepts of Oncidium pulchellum Bello (1883 non Hooker 1827) and of Oncidium sylvestre Lindley (1858) are identical. Bello's concept is to be considered invalid, not only because of the prior synonym Oncidium sylvestre from Lindley 25 years before but also because the homonym Oncidium pulchellum was already validly given to another species (Hooker, 1827).

Herbarium examinations and published descriptions give clear proof that Garay & Stacy (1974) were wrong in treating Oncidium quadrilobium C. Schweinfurth as a synonym of Oncidium leiboldii Rchb.f..

Oncidium quadrilobium C. Schweinfurth is a tiny plant with individual vegetative characteristics and a unique pure yellow flower showing enormous sidelobes of the labellum, whereas Oncidium leiboldii Rchb.f. is a stately plant with white or light rose flowers showing small sidelobes of the labellum.

Oncidium sasseri (Moir 1975) and Oncidium scandens (Moir 1968) are possibly geographic variants of Oncidium bahamense Nash ex Britton & Millspaugh.

Oncidium tenellum (Gerard 1847) was described in a very rare Journal of which only 2 or 3 volumes have been published, the only existing copy I know of in Europe being deposited in the Library of the "Nationale Plantentuin" in Meise near Brussels in Belgium. The plate accompanying the description shows a non-stoloniferous species with flowers somewhat resembling those of Oncidium tetrapetalum (Jacq.) Willdenow. Lemée (1855), Cogniaux (1910), Kränzlin (1922) as well as Garay (1970) and Garay and Stacy (1974) list the taxon as a valid species (whereby Cogniaux based his publication on Gérard, Kränzlin on Cogniaux and Garay and Stacy on Kränzlin). The description in the Portefeuille des Horticulteurs and in the Flore de la Guiane Française correspond to the descriptions of Oncidium tetrapetalum (Jacq.) Willdenow as well as to the ob-

servations made on living plants of that species.

Oncidium tetrapetalum (Jacq.) Willd. was originally described as Epidendrum tetrapetalum by Jacquin in 1760. The species was recombined as Cymbidium tetrapetalum (Swartz 1799a) and later on invalidly as Oncidium quadripetalum (Swartz 1800). Finally, Willdenow (1806) redescribed the taxon as Oncidium tetrapetalum. Since then, this same species has been described as Oncidium pauciflorum (Lindley 1821), Oncidium tricolor (Hooker 1844) and Oncidium guttatum (Fawcett & Rendle 1910 non Rchb.f. 1863).

Oncidium urophyllum Loddiges ex Lindley was also published a second time as Oncidium tetrapetalum by Grisebach in 1864. Here again, the latter name is invalid as the concept of Oncidium urophyllum was published validly at an earlier date and besides that, the name Oncidium tetrapetalum was already applied to another species as an earlier homonym (Jacquin 1760).

4. 2. RECLASSIFICATION OF THE "VARIEGATA" ONCIDIUMS.

A number of authors have expressed the need for a new revision of the genus Oncidium (Dodson & Dressler 1972, Williams & Dressler 1973, Brieger 1975, Dressler 1975, Braem 1980, Lückel & Braem 1982, Dressler 1981, Dressler & Williams 1982). Such revision, when done according to "natural" phylogenetic complexes might suggest that the "Variegata" Oncidiums are to be separated from the rest of the genus, just like the genera Antillanorchis (Garay & Stacy 1974), Cyrtochilus [Kunth (HBK) 1815], Mexicoa (Garay & Stacy 1974), Psychopsis (Rafinesque 1838), Psychopsiella (Lückel & Braem 1982) and Psygmorchis (Dodson & Dressler 1972).

As a matter of fact, Rafinesque did separate three of the species belonging to the "Variegata" Oncidiums from the genus in his Flora Telluriana (1837-1838) [1]. He created the genus Olgasis for Olgasis triquetra (Pars secunda, No. 183), the genus Tolumnia for Tolumnia pulchella (Pars secunda, Nos. 382, 383) and the genus Xaritonia (which I included in Tolumnia) for Xaritonia tetrapetala (Pars quarta, No. 806). Although Rafinesque's work has been neglected for many years for a number of reasons (Merrill 1949), these 3 genera are validly published (Merrill 1949, Butzin 1983).

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(1) Although on all parts of Rafinesque's Flora Telluriana the date of publication is indicated as being 1836, it has been conclusively proven that parts 1, 2 and 3 were published in 1837 and that part 4 was published in 1838.
Rafinesque was an extremely introverted eccentric (Merrill 1949) who published his books and pamphlets himself. This meant that his publications were printed in a limited edition only. Of the Flora Telluriana only 160 copies were printed. Upon Rafinesque's death, the remaining copies of his books were sold in bulk as "waste paper". Therefore, it is quite understandable that the Flora Telluriana (and all the other books of Rafinesque) are now extremely rare.

Garay's decision to select Oncidium variegatum (Sw.) Sw. as lectotype for the genus and the endorsement by the Committee for Spermatophyta in 1978 (Stafleu 1978) inhibited the bulk separation of the "Variegata" Oncidiums from all other species of the genus.

However, single species are so different from all others that a separation was possible. Oncidium henekenii was separated as Hispaniella henekenii (Braem 1980). The genus Olgasis was reinstated for Olgasis gauntlettii and Olgasis triquetrum (Braem 1984). Oncidium arizajulianum was separated as Braasiella arizajuliana (Braem, Lückel & Rüssmann 1984).

Through the new decision of the Committee for Spermatophyta (Stafleu 1985), the situation has been changed considerably. As Oncidium variegatum (Sw.) Sw. is no longer the type species for the genus, that species, together with its relatives can now be transferred to a separate genus.
As Rafinesque has already created two separate genera for typical plants of the "Variegata" Oncidiums the remaining species were transferred to Tolumnia (Braem 1986).

These transfers result in the following reclassification of the "Variegata" Oncidiums. The result is that all species that I am chiefly concerned with in this thesis are no longer placed in the genus Oncidium.

Table 8 : Species formerly classified in Oncidium section Oncidium and their classification into separate genera.

Braasiella Braem et al.	Hispaniella Braem	Ogasis Rafinesque	Tolumnia Rafinesque
B. arizajulianum	H. henekeni	O. gauntlettii	T. bahamensis
		O. triquetra	T. calochila
			T. compressicaulis
			T. guianensis
			T. haitiensis
			T. hawkesiana
			T. leiboldii
			T. lemoniana
			T. lucayana
			T. x osmentii
			T. prionochila
			T. pulchella
			T. quadrilobia
			T. sasseri
			T. scandens
			T. sylvestris
			T. tetrapetala
			T. tuerckheimii
			T. urophylla
			T. usneoides
			T. variegata
			T. velutina

4. 2. 1. SYNOPSIS OF THE GENUS BRAASIELLA Braem et al.

Braasiella Braem, Lückel & Rüssmann (1984)

Die Orchidee 35(3): 113-115.

Type: Oncidium arizajulianum Withner & Jimenez 1967

This is a monospecific genus, typified by the extremely long, beaklike rostellum, the structure of the pollinarium, free lateral sepals and stalked leaves.

Braasiella arizajuliana is known only from the island of Hispaniola where the plants grow epiphytically on trees overhanging rivers and streams

2n = no counts in literature.

Figure 2 :

Braasiella arizajuliana
(x 6.1)

4. 2. 2. SYNOPSIS OF THE GENUS HISPANIELLA Braem.

Hispaniella Braem (1980)

Die Orchidee 31(4): 144.

Type: Oncidium henekenii Schomburgk ex Lindley 1855

This monospecific genus is easily recognized by the bee-like flowers which can only be compared with those of some species of the European genus Ophrys.

Hispaniella henekenii is only known from the island of Hispaniola and grows epiphytically on the small twigs of thorny bushes in dry areas

2n = 40

Figure 3 :

Hispaniella henekenii
(x 4.2)

4. 2. 3. SYNOPSIS OF THE GENUS OLGASIS Rafinesque

Olgasis Rafinesque (1837)
Flora Telluriana Pars Secunda, No. 183

Type: Epidendrum triquetrum Swartz 1788

Synonyma: Cymbidium triquetrum (Sw.) Swartz (1799)
Jamaiciella triquetra (Sw.) Braem (1980)
Oncidium dubium E. André (1873)
Oncidium triquetrum (Sw.) R. Brown (1813)

Further species:

Olgasis gauntlettii (Withner & Jesup) Braem (1984)

Basionym: Oncidium gauntlettii Withner & Jesup (1964)

Synonym: Jamaiciella gauntlettii (Withner & Jesup) Braem (1980)

Olgasis gauntlettii differs from Olgasis triquetra not only in a smaller vegetative habit but also in a number of floral characteristics. The lateral petals are relatively small and the dorsal petal (the labellum) is rounded and not triangular as in Olgasis triquetra. The flower colour is entirely different. Olgasis gauntlettii was made synonymous to Olgasis triquetra by Garay (1970) but treated as a separate species by Garay and Stacy (1974).

The genus Olgasis was created by Rafinesque (1837) on the basis that Olgasis triquetra lacked the callus on the basis of the labellum.

Both species belonging to this genus are endemic to Jamaica. They grow as tree epiphytes near flowing waters in semi-shaded or fully shaded conditions.

2n = 42

Figure 4 :

Olgasis gauntlettii
(x 4.5)

Figure 5 :

Olgasis triquetra
(x 3.4)

4. 2. 4. SYNOPSIS OF THE GENUS TOLUMNIA Rafinesque

Tolumnia Rafinesque (1837)

Flora Telluriana Pars secunda Nos. 382, 383

Type: Oncidium pulchellum Hooker 1827

Synonyma: Genus Xaritonia Rafinesque (1838)

Type: Epidendrum tetrapetalum Jacquin

Oncidium section Equitantia Lindley ex Paxton (1850)

Type: Oncidium variegatum (Swartz) Swartz

Oncidium section Tolumnia

(Rafinesque) O. Kuntze (1903)

Type: Oncidium pulchellum Hooker

Oncidium section Aphanobulbia-Variegata

Kränzlin (1922)

Type: Oncidium variegatum (Swartz) Swartz

Oncidium section Oncidium (Garay & Stacy 1974)

Type: Oncidium variegatum (Swartz) Swartz

The genus Tolumnia is characterized by a miniature dipodial growth habit, distichous succulent leaves, flowers with united lateral sepals, the structure of the column with its prominent column wings, a prominent callus on the basis of the labellum, as well as by a distinct geographical isolation within the Caribbean region.

2n = 40,42,84,126,133

This group of orchids can easily be divided in two complexes on the basis of vegetative habit (Braem 1986). However, as the floral characteristics do not differ considerably between both complexes, I have divided the genus into two subgenera rather than creating another genus to accommodate the stoloniferous species.

Figure 6 : Stoloniferous and non-stoloniferous habits of the genus Tolumnia Rafinesque.

Stoloniferous

Non-stoloniferous

Subgenus Tolumnia

Type: Oncidium pulchellum Hooker 1827 non Bello 1883.

This subgenus is characterized by a non-stoloniferous habit (see Figure 6).

Species belonging to this subgenus:

1. Tolumnia pulchella (Hooker) Rafinesque (1837)

Basionym: Oncidium pulchellum
Hooker (1827) non Bello (1883).

Synonyma: Oncidium concavum Moir (1968)

This species is the type of the genus and therefore automatically the type of this subgenus.

Tolumnia pulchella (Hooker) Rafinesque is an endemic of Jamaica. The plants grow in fairly humid forests as epiphytes on small trees. This species is primarily recognized by its flowers showing a relatively large, rounded, four-lobed, unicoloured white to lilac labellum and lilac column wings. The triquetrous, succulent leaves are distichous and show quite clearly an abscission layer of breakaway cells near their base.

2n = 42.

Figure 7 :

Tolumnia pulchella
(x 4.4)

2. Tolumnia calochila (Cogniaux) Braem 1986.

Basionym: Oncidium calochilum Cogniaux (1910)

This species is easily recognized by its terete leaves and pure yellow flower with fringed margins to the labellum. Tolumnia calochila (Cogniaux) Braem is an endemic of Hispaniola where it grows epiphytically on trees and shrubs in semi-arid areas near the coast.

2n = 42.

Figure 8 :

Tolumnia calochila
(x 5.7)

3. Tolumnia compressicaulis (Withner) Braem 1986.

Basionym: Oncidium compressicaulis Withner (1966)

Tolumnia compressicaulis (Withner) Braem is an endemic of the mountain regions of Hispaniola. This species grows in very cool conditions at elevations between 1500 and 2000 m. as an epiphyte on small trees or shrubbery.

The plants are easily recognized by the laterally flattened base of the inflorescence, a feature unique within this group of orchids.

2n = no counts in literature.

Figure 9 :

Tolumnia compressicaulis
(x 4.7)

4. Tolumnia guianensis (Aubl.) Braem 1986.

Basionym: Ophrys guianensis Aublet (1775)

Synonyma: Oncidium barahonense Hort. ex Moir (1959)

Oncidium desertorum Nash ex Withner (1967)

Oncidium guianense (Aublet) Garay (1973)

Oncidium intermedium Bertero ex Sprengler (1826)

Oncidium perchoiri Hort. ex Moir (1959)

Ophrys aloidea Poiret (1798)

This is another endemic of Hispaniola. Like Tolumnia variegata (Swartz) Braem, with which it is often found growing sympatrically, this is a very adaptable species found in semi-arid and arid areas as well as under moist conditions. The species is readily recognized by its large lateral petals which are almost as big as the labellum.

2n = 40.

Figure 10 :

Tolumnia guianensis
(x 3.0)

5. Tolumnia haitiensis (Leonard & Ames ex Ames) Braem 1986.

Basionym: Oncidium haitiense Leonard & Ames ex Ames (1922)

Again a species endemic to Hispaniola. The plants grow in semi-arid regions as epiphytes on small shrubs and are readily recognized by their flower morphology. The flowers show a typical unicolored yellow, four-lobed labellum with a callus composed of blunt, finger shaped protrusions.

2n = no count in literature.

Figure 11 :

Tolumnia haitiensis
(6.0)

6. Tolumnia leiboldii (Rchb.f.) Braem 1986.

Basionym: Oncidium leiboldii Rchb.f. (1863)

Synonyma: Oncidium caymanense Moir (1968)

A species found in Cuba and on the Cayman Islands, rarely in cultivation.

The flowers of this species are predominantly white with a dark brown base of the labellum. The borders of the basal section of the labellum are denticulate.

2n = 40,42.

Figure 12 :

Tolumnia leiboldii
(x 4.0)

7.. Tolumnia lemoniana (Lindley) Braem 1986.

Basionym: Oncidium lemonianum Lindley (1835)

Synonym: Oncidium guibertianum A. Richard (1850)

An endemic of Cuba. This species grows epiphytically in dense forests at low levels. The plants have yellow flowers spotted with purple. The flowers are characteristic in their overall morphology.

There are two varieties of this species which are vegetatively different enough to warrant the division of the species into two subspecies.

A. Plants with triquete leaves:

Tolumnia lemoniana ssp. lemoniana

Basionym: Oncidium lemonianum Lindley 1835

Edwards's Botanical Register, 21, t. 1789

B. Plants with terete leaves:

Tolumnia lemoniana ssp. guibertiana (A. Richard) Braem, comb. nov. et stat. nov

Basionym: Oncidium guibertianum A. Richard 1850

in Ramon de la Sagra. Hist. Cub. 11:244, t. 81

2n = 42.

Figure 13 :

Tolumnia lemoniana ssp. guibertiana
(x 1.1)

8. Tolumnia lucayana (Nash ex Britton & Millspaugh) Braem 1986.

Basionym: Oncidium lucayanum Nash ex Britton & Millspaugh (1920)

Synonyma: Oncidium lyratum Withner (1967)
Oncidium moirianum Osment (1972)

Tolumnia lucayana (Nash ex Britton & Millspaugh) Braem is a very variable species. It occurs on the Bahamas and in Cuba. The plants are easily recognized by the small, sabre-shaped green leaves which are densely spotted purple.
2n = 40.

Figure 14 :
Tolumnia lucayana
(x 5.1)

9. Tolumnia prionochila (Krzl.) Braem 1986.

Basionym: Oncidium prionochilum Kränzlin (1922)

This species seems to be an intermediate between the subgenera as indicated by its vegetative habit. The plants form adventitious plants ("Keikis") at the internodes of the extremely long flower stalk but they do not have stolons. The flowers are unicoloured yellow with irregular margins of the labellum. This species grows epiphytically on shrubs very near to the coast in the British and American Virgin Islands.

2n = no counts in literature.

Figure 15 :

Tolumnia prionochila
(x 5.4)

10. Tolumnia quadrilobia (C. Schweinfurth) Braem 1986.

Basionym: Oncidium quadrilobium C. Schweinfurth (1946)

This species is an endemic of Hispaniola. The plants grow as twig epiphytes on shrubs in extremely arid areas, often together with Tolumnia variegata (Swartz) Braem, Tolumnia guianensis (Aublet) Braem and Hispaniella henekenii (Schomburgk ex Lindley) Braem.

This species is easily recognized by its miniature growth and its pure yellow flowers with, in comparison to the other members of the genus, enormous side lobes of the lip. This species also differs from all others species within the "Variegata" in that the seed capsule is spheroid with a spiny surface (see chapter 4.4.2.2.6.).

2n = 40.

Figure 16 :

Tolumnia quadrilobia
(x 5.0)

11. Tolumnia tetrapetala (Jacquin) Braem 1986.

Basionym: Epidendrum tetrapetalum Jacquin (1760)

Synonyma: Cymbidium tetrapetalum (Jacquin) Swartz (1799)

Oncidium apiculatum Moir (1968)

Oncidium berenyce Reichenbach f. (1862)

Oncidium cuneilabium Moir (1968)

Oncidium guttatum Fawcett & Rendle (1910)

Oncidium pauciflorum Lindley (1821)

Oncidium quadripetalum Swartz (1800)

Oncidium tenellum Gerard (1847)

Oncidium tetrapetalum

(Jacquin.) Willdenow (1806)

Oncidium tricolor Hooker (1844)

Xaritonia tetrapetala

(Jacquin) Rafinesque (1838)

Tolumnia tetrapetala (Jacq.) Braem is another endemic of Jamaica. The plants grow epiphytically on small trees in low altitudes, often only a few meters from the seashore.
This species is extremely variable in flower colour and shape of the labellum and I think it quite possible that a divergence towards different separate species is taking place.
The species is recognized by its relatively long triquetrous leaves and flowers of a white ground colour sometimes suffused by a pink or lilac hue. The petals and sepals are striped reddish brown.
2n = 42.

Figure 17 :

Tolumnia tetrapetala
(x 5.6)

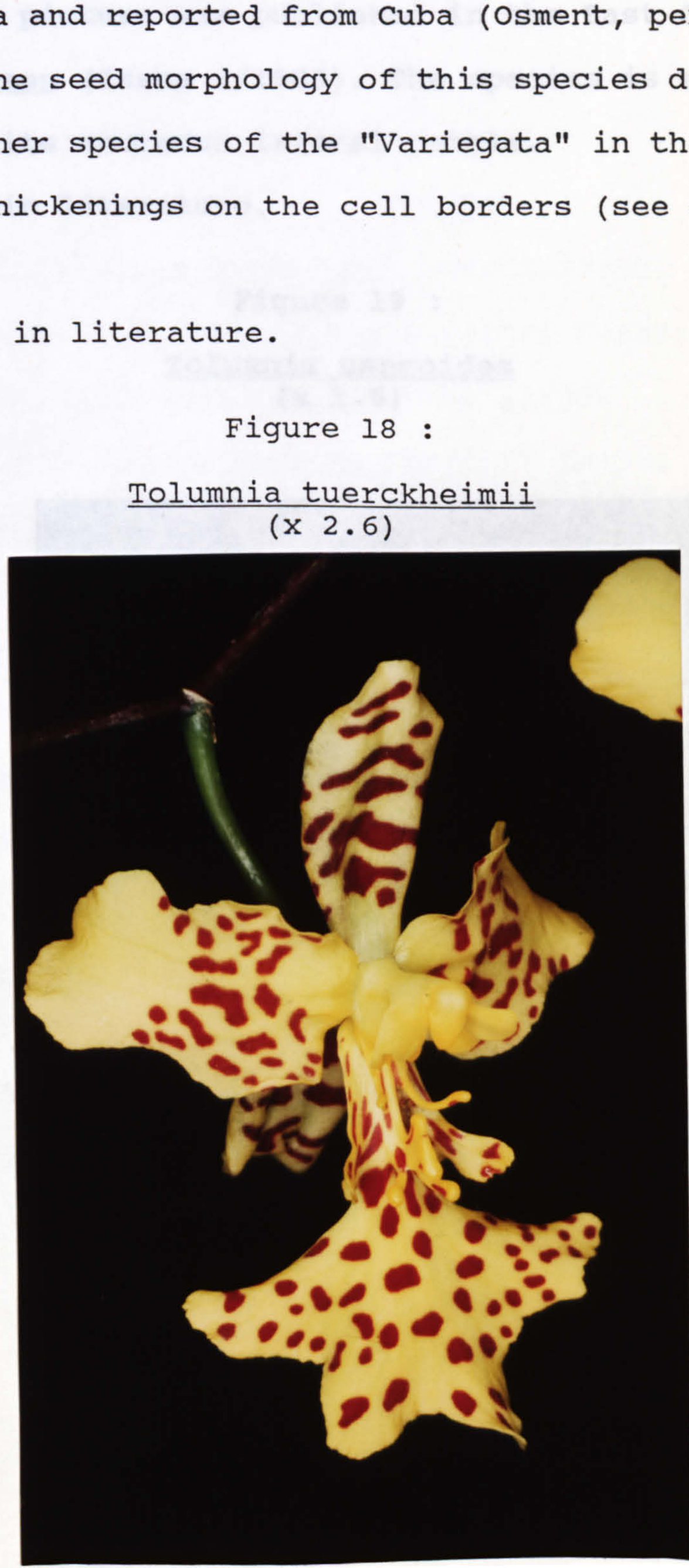
12. Tolumnia tuerckheimii (Cogniaux) Braem 1986.

Basionym: Oncidium tuerckheimii Cogniaux (1912)

This species is easily recognized by its vegetative habit. The plants grow upside down (leaves pointing downwards) at altitudes between 500 meters and the treeline. This species is known from Hispaniola and reported from Cuba (Osment, personal communication). The seed morphology of this species differs from that of all other species of the "Variegata" in that it does not show any thickenings on the cell borders (see chapter 4.4.2.2.7.)

2n = no counts in literature.

Figure 18 :
Tolumnia tuerckheimii
(x 2.6)



13. Tolumnia usneoides (Lindley) Braem 1986.

Basionym: Oncidium usneoides Lindley (1858)

Until recently, this species was known only from herbarium specimens. It is an endemic of Cuba. Some time ago, Tolumnia usneoides was rediscovered by the East German botanist Helga Dietrich and a picture was published in the East German Orchid Journal Orchideen (Issue 3/1985). The species is easily recognized by its enormous lateral petals.

2n = no count in literature.

Figure 19 :

Tolumnia usneoides
(x 1.6)

Subgenus Variegata Braem (1986)

Type: Epidendrum variegatum Swartz 1788

This subgenus is characterized by a stoloniferous habit. This means that the plants make stolons with adventitious plants at the end (Figure 6.).

Species belonging to this subgenus:

14. Tolumnia variegata (Swartz) Braem 1986.

Basionym: Epidendrum variegatum Swartz (1788)

Synonyma: Cymbidium variegatum (Swartz) Swartz (1799)

Epidendrum carinatum Vahl (1793)

Oncidium variegatum (Swartz) Swartz (1800)

This is the most widespread species within the genus. Tolumnia variegata (Swartz) Braem occurs on the Bahamas, Cuba, Hispaniola and Puerto Rico. The plants grow epiphytically on trees and shrubs from sea-level to about 2000 m. This species is to be found in arid and semi-arid areas as well as in moist locations.

Tolumnia variegata is characterized by its broadly sabre shaped leaves with toothed margins and a broad-lipped predominantly white flower which in overall form is very variable. The stolons are relatively short, giving the species a tufted habit.

2n = 40, 42.

Figure 20 :

Tolumnia variegata
(x 4.8)

15. Tolumnia bahamensis (Nash ex Britton & Millspaugh) Braem 1986.

Basionym: Oncidium bahamense Nash ex Britton & Millspaugh (1920)

This species is known from the Bahama Islands and from the south of Florida. It differs from Tolumnia variegata (Swartz) Braem in its semi-terete leaves and the number of its chromosomes.

2n = 84.

Figure 21 :

Tolumnia bahamensis
(x 5.4)

16. Tolumnia hawkesiana (Moir) Braem 1986.

Basionym: Oncidium hawkesianum Moir (1967)

Tolumnia hawkesiana (Moir) Braem is possibly identical with Tolumnia sylvestre (Lindley) Braem. The species is endemic to Cuba and only a few specimens are in culture. It is easily recognized by its small leaves, its numerous thin aerial roots and its very small, pink flowers.

2n = 133.

Figure 22 :

Tolumnia hawkesiana
(5.6)

17. Tolumnia sasseri (Moir) Braem 1986.

Basionym: Oncidium sasseri Moir (1975)

The study of the available herbarium material and literature causes me to suggest that this species may be a variant of Tolumnia bahamensis (Nash ex Britton & Millspaugh) Braem which is found on the Bahamas. The plants can be recognized by their small, falcate , sharply pointed leaves and the thin, few flowered, long peduncle. The flowers are not as wide as those of Tolumnia variegata and are always widest across the petals.

2n = 84.

Figure 23 :

Tolumnia sasseri
(x 6.9)

18. Tolumnia scandens (Moir) Braem 1986.

Basionym: Oncidium scandens Moir (1968)

This may be the Haitian variant of Tolumnia bahamense (Nash ex Britton & Millspaugh) Braem. The plants grow semi-terrestrially between high grass tussocks at altitudes above 1500 m. The plants can be recognized by the elongated erect habit caused by long stolons. The flowers are white to purple with a somewhat convex lip.

2n = 84.

Figure 24 :

Tolumnia scandens
(x 6.2)

19. Tolumnia sylvestris (Lindley) Braem 1986

Basionym: Oncidium sylvestre Lindley (1858)

Synonym: Oncidium pulchellum Bello (1883)

A species endemic to Cuba which is extremely rare in cultivation. The plants have small triquetrous leaves. The peduncle is elongated with widely spaced flowers.

2n = 126.

Figure 25 :

Tolumnia sylvestris
(x 3.7)

20. Tolumnia urophylla (Loddiges ex Lindley) Braem 1986

Basionym: Oncidium urophyllum Loddiges ex Lindley (1842)

This species is easily recognized as it is the only stoloniferous species with yellow flowers. It is one of the two species of the genus occurring on the Lesser Antilles, the second one being Tolumnia prionochilum (Kränzlin) Braem. Tolumnia urophylla (Loddiges ex Lindley) Braem is a twig epiphyte growing at low elevations, often very near the beach.

2n = 84.

Figure 26 :

Tolumnia urophylla
(x 3.7)

21. Tolumnia velutina (Lindley ex Paxton) Braem 1986.

Basionym: Oncidium velutinum Lindley ex Paxton (1851)

A species closely related to Tolumnia variegata (Swartz) Braem, only differing in the chromosome count, a somewhat smaller habit, and a velvet structured midlobe of the labellum.

2n = 84.

Figure 27 :

Tolumnia velutina
(x 5.0)

Natural Hybrid:

22. Tolumnia x osmentii (Withner) Braem 1986.

Basionym: Oncidium osmentii Withner (1967)

Synonym: Oncidium x osmentii (Withner) Moir (1972)

This plant is an intermediate between Tolumnia haitiensis (Leonard & Ames ex Ames) Braem and Tolumnia quadrilobia (C. Schweinfurth) Braem as proven by horticultural hybridization (Moir 1972). The hybrid is intermediate in flower structure. 2n = no counts in literature.

Figure 28 :
Tolumnia x osmentii
(x 5.0)

4. 3. FIELD WORK

4. 3. 1. ORIGIN AND MAINTENANCE OF LIVING MATERIAL

4. 3. 1. 1. GENERAL REVIEW OF COLLECTING TRIPS

When I started preparations for this work, it was impossible to obtain any living material of the "Variegata" Oncidiums in Europe.

Only a few Botanical Gardens had any species in cultivation.

No commercial orchid dealer in Europe was able to supply any material of any of the species.

Most of the plant material used for this study was either collected by myself during 4 research trips to the Caribbean Islands or purchased from various commercial orchid dealers in the U.S.A. or on Jamaica. Material of Tolumnia urophylla was discovered labelled as Cactaceae in a Dutch nursery. Some material was donated by various institutions or persons, and some material was already available in my collection of living plants.

In 1981, 1982 and 1983, I visited Jamaica and collected Olgasis gauntlettii, Olgasis triquetra, Tolumnia pulchella and Tolumnia tetrapetala.

In 1983 and 1984, I visited Hispaniola and collected Braasiella arizajuliana, Hispaniella henekenii, Tolumnia calochila, Tolumnia compressicaulis, Tolumnia guianensis, Tolumnia haitiensis, Tolumnia x osmentii, Tolumnia quadrilobia, Tolum-

nia scandens, Tolumnia tuerckheimii, Tolumnia variegata and Tolumnia velutina.

A collecting trip to Cuba in September 1984 was unsuccessful.

4. 3. 1. 2. PROVENANCE OF LIVING MATERIAL (1)

(Each number refers to a single genetical individual)

Braasiella arizajuliana

1. Collected on the Banks of the Boa River, Dominican Republic, 25.7.83, G. J. Braem.

2. ditto

3. ditto

4. Donated by the Moscoso Botanical Gardens, Santo Domingo, Dominican Republic, provenance Haiti, collected by D. D. Dod, date and exact location of collection unknown.

Hispaniella henekenii

5. Purchased from Perreira Orchids, Hawaii, USA, May 1979, provenance unknown.

6. Purchased from Osment Orchids, Florida, USA, September 1979, provenance unknown.

7. Collected near Villa Elisa, Dominican Republic, 23.7.1983, G. J. Braem.

8. ditto

9. ditto

Olgasis gauntlettii

10. Purchased from Noel Gauntlett, Kingston, Jamaica, Spring 1979. Collected by Noel Gauntlett, location and date of collection unknown.

11. ditto

Olgasis triquetra

12. Purchased from Osment Orchids, Florida, USA, data as above.

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(1) Living material of the Cuban endemic species Tolumnia hawkesiana, Tolumnia sylvestris and Tolumnia lemoniana as well as some plants of Tolumnia variegata were obtained through channels which cannot be disclosed in order not to endanger my correspondents in the German Democratic Republic. For this material, the provenance cannot be indicated in detail.

13. Collected along the White River near Lodge, 6 km southwest of Ocho Rios, Jamaica, 21.3.81, G. J. Braem.

14. ditto

15. Seedlings, progeny of a cross made by G. Röllke, Bielefeld, Federal Republic of Germany, the parents being two plants collected by G. J. Braem along the White River near Ocho Rios, Jamaica, data as above.

Tolumnia bahamensis

16. Purchased from Osment Orchids, Florida, USA, data as above.

17. ditto

18. ditto

Tolumnia hawkesiana

19. Purchased from Osment Orchids, Florida, USA, data as above.

20. Cuba, collected 1984, about 20 km north of Havanna, about sea-level.

21. ditto

Tolumnia sasseri

22. Purchased from Osment Orchids, Florida, USA, data as above.

Tolumnia scandens

23. Purchased from Osment Orchids, Florida, USA, data as above.

24. Collected approximately 1 km north of Kenskoff, Haiti, altitude 1600 m., 17.7.1983, G. J. Braem.

25. ditto

Tolumnia sylvestris

26. Cuba, collected 1983, Province Guantanamo. Details of habitat unknown.

27. ditto

Tolumnia urophylla

28. Purchased from Osment Orchids, Florida, USA, data as above.

29. Purchased from De Bruin, Holland, Autumn 1980, provenance indicated as being the Isle of Saba, Lesser Antilles.
Data dubious as plant was labelled with the name of a Cactus.

30. ditto

31. ditto

Tolumnia variegata

32. Purchased from Osment Orchids, Florida, USA, data as above.

33. ditto

34. Cuba, collected 1984, vicinity of Havanna, sea-level.

35. Collected on the Road between Port au Prince and Kenskoff, Haiti, altitude 650 m. 19.7.1983, G. J. Braem.

36. Collected near Bayahibe, Dominican Republic, altitude 0 m., 24.7.1983, G. J. Braem.

37. ditto

Tolumnia velutina

38. Purchased from "Orchids by the Sea", Florida, 1980, provenance unknown.

39. ditto

Tolumnia calochila

40. Purchased from Osment Orchid, Florida, USA, data as above.

41. Collected near Bayahibe, Dominican Republic, about sea-level, 25.7.1983, G. J. Braem.

42. ditto, collected 28.4.1984.

Tolumnia compressicaulis

43. Purchased from Osment Orchids, Florida, USA, data as above.

44. Collected about 2 Km north of Kenskoff, Haiti, 17.7.1983, G. J. Braem.

45. ditto

Tolumnia guianensis

46. Purchased from Osment Orchids, Florida, USA, data as above.

47. ditto - var. alborubrum

48. ditto - var. aureorubrum

49. Collected on the roadside between Port au Prince and Kenskoff, Haiti, altitude 780 m., 20.7.1983, G. J. Braem.

50. Ditto - var. alborubrum.

51. Collected near Bayahibe, Dominican Republic, about sea-level, 24.7.1983, G. J. Braem.

52. ditto

53. ditto - var. alborubrum

54. ditto - var. aureorubrum

Tolumnia haitiensis

55. Purchased from Osment Orchids, Florida, USA, data as above.

56. Donated by the Moscoso Botanic Gardens, Santo Domingo, Dominican Republic, collected by D. D. Dod, exact location and date of collection unknown.

Tolumnia leiboldii

57. Purchased from "Orchids by the Sea", Florida, USA, 1980, provenance unknown.

Tolumnia lemoniana ssp. lemoniana

58. Cuba, 1983, place of collection unknown.

Tolumnia lemoniana ssp. guibertiana

59. Cuba, 1984, about 40 km west of Havanna, near sea-shore.

Tolumnia lucayana

60. Purchased from "Flor Brazil Pfister", Mannheim, Federal Republic of Germany, Summer 1980, provenance unknown.

61. ditto

62. var. aurea, purchased from Osment Orchids, Florida, USA, data as above.

Tolumnia prionochila

63. Purchased from Osment Orchids, Florida, USA, data as above.

64. ditto

Tolumnia pulchella

65. Purchased from Perreira Orchids, Hawaii, May 1979, provenance unknown.

66. Collected near Steward Town, Jamaica, 11.4.1981, altitude 400 m., G. J. Braem.

67. ditto

68. Collected near Balaclava, Jamaica, 12.4..1981, altitude 250 m., G. J. Braem.

Tolumnia quadrilobia

69. Purchased from Osment Orchids, Florida, USA, data as above.

70. Donated by the Moscoso Botanical Garden, Santo Domingo, Dominican Republic, collected by D. D. Dod, location and date of collection unknown.

71. Collected near Villa Elisa, Dominican Republic, altitude 100 m., 23.7.1983, G. J. Braem.

Tolumnia tetrapetala

72. Purchased from Perreira Orchids, Hawaii, Mai 1979, provenance unknown.

73. Purchased from N. Gauntlett, Kingston, Jamaica, Spring 1978, provenance unknown.

74. Collected at South West Point, Jamaica, 2.4.1981, altitude 0 m., G. J. Braem.

75. Collected near Hunt's Pen, Jamaica, 4.4. 1981, altitude 70 m., G. J. Braem.

Tolumnia tuerckheimii

76. Collected in Massif de la Hotte, Haiti, altitude 2100 m., 19.7.1983, G. J. Braem.

77. Collected at Rio Frio, near Kenskoff, altitude 700 m., 16.7.1983, G. J. Braem.

Tolumnia x osmentii

78. Purchased from Osment Orchids, Florida, USA, data as above.

79. Donated by the Moscoso Botanical Garden, Santo Domingo, Dominican Republic, collected by D. D. Dod. Date and location of collection unknown.

Origin of live material of reference species (i.e. not "Variegata" Oncidiums):

80. Brassia spec. accession number E. 701 164 Collected by Maurice Mason, Talbot Manor, Kings Lynn, Norfolk, England in the neighbourhood of Meddelin, Colombia, ca. 1500 m. above sealevel. Received by Royal Botanic Gardens, Edinburgh on 3. March 1970.
81. Cochleoda noezliana accession number E. 960 154 received by Royal Botanic Gardens, Edinburgh from Dr. J. Foulis, Edinburgh on 3. August 1896.
82. Cochleoda rosea accession number E. 200 084 received by Royal Botanic Gardens, Edinburgh from Mr. Inglis, 8 Brighton Place, Portobello, Edinburgh on 26. November 1920.
83. Maxillaria porphyrostele accession number E. 570 517 received by Royal Botanic Gardens, Edinburgh from Botanic Gardens Glasgow on 13 December 1957.
84. Maxillaria variabilis accession number E. 593 535 received by Royal Botanic Gardens, Edinburgh from Botanic Gardens Gothenburg, Sweden on 29 June 1959.
85. Oncidium cheirophorum accession number E. 270 080 received by Royal Botanic Gardens, Edinburgh in 1927 from Messrs Armstrong and Brown, Orchidhurst, Sandhurst Park, Tunbridge Wells, England.
86. Oncidium excavatum accession number E. 716 625 no further information obtainable.
87. Oncidium macropetalum accession number E. 813 026 received by Royal Botanic Gardens, Edinburgh from Ball State University, Indiana, USA, in 1981. Collected by Fred Micklow in Bolivia.

88. Oncidium ornithorhynchum accession number E. 611 714 received by the Royal Botanic Gardens, Edinburgh in 1961 from Mrs. Andrews, 4 Correnie Gardens, Edinburgh, no further data obtainable.
89. Oncidium polyadenum accession number E. 701 582 collected in Peru by Maurice Mason. Received by Royal Botanic Gardens, Edinburgh on 9. April 1970.
90. Oncidium porrigens accession number E. 317 28 received by Royal Botanic Gardens, Edinburgh from Messrs Armstrong and Brown, Orchidhurst, Sandhurst Park, Tunbridge Wells, England on 6 July 1928.

all donated by Royal Botanic Gardens, Edinburgh, Spring 1982.

91. Oncidium bicallosum

Collection Braem, "Mexico", purchased from Hennis, Hildesheim, Federal Republic of Germany, Autumn 1978.

92. Oncidium cebolleta

Collection Braem, "Brazil", provenance and date of purchase unknown.

93. Oncidium jonesianum

purchased from Flor Brazil Pfister, Mannheim, Federal Republic of Germany, "Brazil", date unknown.

94. Oncidium lanceanum

purchased from Hennis, Hildesheim, Federal Republic of Germany, Summer 1979, provenance unknown.

95. Oncidium lindenii

donated by Wubben, Holland, Summer 1982. Provenance unknown.

96. Oncidium morenoi

purchased from Orchids by Hauserman, Chicago, USA. Date and provenance unknown.

97. Oncidium nanum

Collection Braem, "Brazil", provenance and date of purchase unknown.

98. Oncidium nudum

purchased from Dinges, Oberursel, Federal Republic of Germany, Summer 1981. Provenance unknown.

99. Oncidium pubes

purchased from Flor Brazil Pfister, Mannheim, Federal Republic of Germany, Winter 1981.

Provenance unknown.

100. Oncidium pumilum

purchased from Orchideen Dinges, Oberursel, Federal Republic of Germany, "Brazil", date unknown.

101. Oncidium robustissimum

Collection Braem, no further data available.

102. Oncidium splendidum

Collection Braem, no further data available.

103. Oncidium schillerianaum

purchased from Trautmann Orchids, Stuttgart, Federal Republic of Germany, April 1981.

104. Oncidium stipitatum

Collection Braem, "Panama", no further data available.

105. Oncidium stramineum

Collection Braem, "Mexico", no further data available.

106. Psychopsiella limminghei

Purchased from Flor Brazil Pfister, Mannheim, Federal Republic of Germany, "Brazil". date unknown.

107. Psychopsis krameriana

Purchased in street, San José, Costa Rica, 29.6.1983. No information on date and location of collection known.

108. Psychopsis papilio

donated by H. Popow, Orchids, Wolfsburg, Federal Republic of Germany, provenance and date unknown.

Supplementary note:

Herbarium material of Tolumnia usneoides was kindly sent from Kew Gardens, allowing some biochemical work to be achieved

4. 3. 1. 3. MAINTENANCE OF LIVING MATERIALS

All plants were cultivated in a greenhouse. Temperatures were kept between 22 and 35° C. during daytime and above 14° C. during the night. From March through October, the greenhouse was shaded with orange shading cloth with a shading capacity of 50%. Humidity was kept above 70% at all times using a fog humidifier. All plants were watered in the morning and in the evening. Normally rain water was used.

One part of the plants was mounted on treefern slabs or Oak-bark underlying the roots with some osmunda fibers mixed with some sphagnum moss.

A second part of the plants was potted in a mixture of Osmunda fibers, styropore and moss.

A third part of the plants was simply set into clay pots without any growing medium at all.

Light intensity was kept high and artificial fertilizers were kept to a minimum.

The orchids grew best and flowered regularly when simply stuck in an empty clay pot, as long as the light intensity was kept high, and as long as the plants were allowed to dry out between waterings. These conditions were obtained by using ventilators set to rotate after each watering.

4. 3. 2. FIELD ANALYSIS

The trips to the Caribbean Islands yielded not only abundant plant material but also a number of interesting ecological data.

4. 3. 2. 1. DISTRIBUTION OF THE TAXA

The distribution of the species of the genera Braasiella, Hispaniella, Olgasis and Tolumnia is restricted to the Caribbean Isles with the exception of Tolumnia bahamensis, a species also occurring in the Everglades, a swamp area on the extreme south of the Florida peninsula, U.S.A. (1). The indication that Tolumnia pulchella (Hooker) Rafinesque occurs or occurred in the Guianas can be considered misleading information based on shipment data of last century. From information found in the Herbaria it can be asserted that the plants were collected in Jamaica but shipped to England from a mainland port, resulting in erroneous information concerning their origin. Analogously, one of the herbarium sheets with Tolumnia urophylla (Loddiges ex Lindley) Braem bears a note in Lindley's handwriting stating the origin to be Brazil. Unfortunately; the data found in the Herbaria of Kew and Vienna is often still considered as non plus ultra and therefore, misleading and erroneous data is to this day often copied without checking its value.

Accordingly, Pabst and Dungs (1977) included Tolumnia urophylla in their Orchidaceae Brasiliensis. G. F. Pabst (in

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(1) In this area the same climatic conditions as in the Caribbean basin prevail.

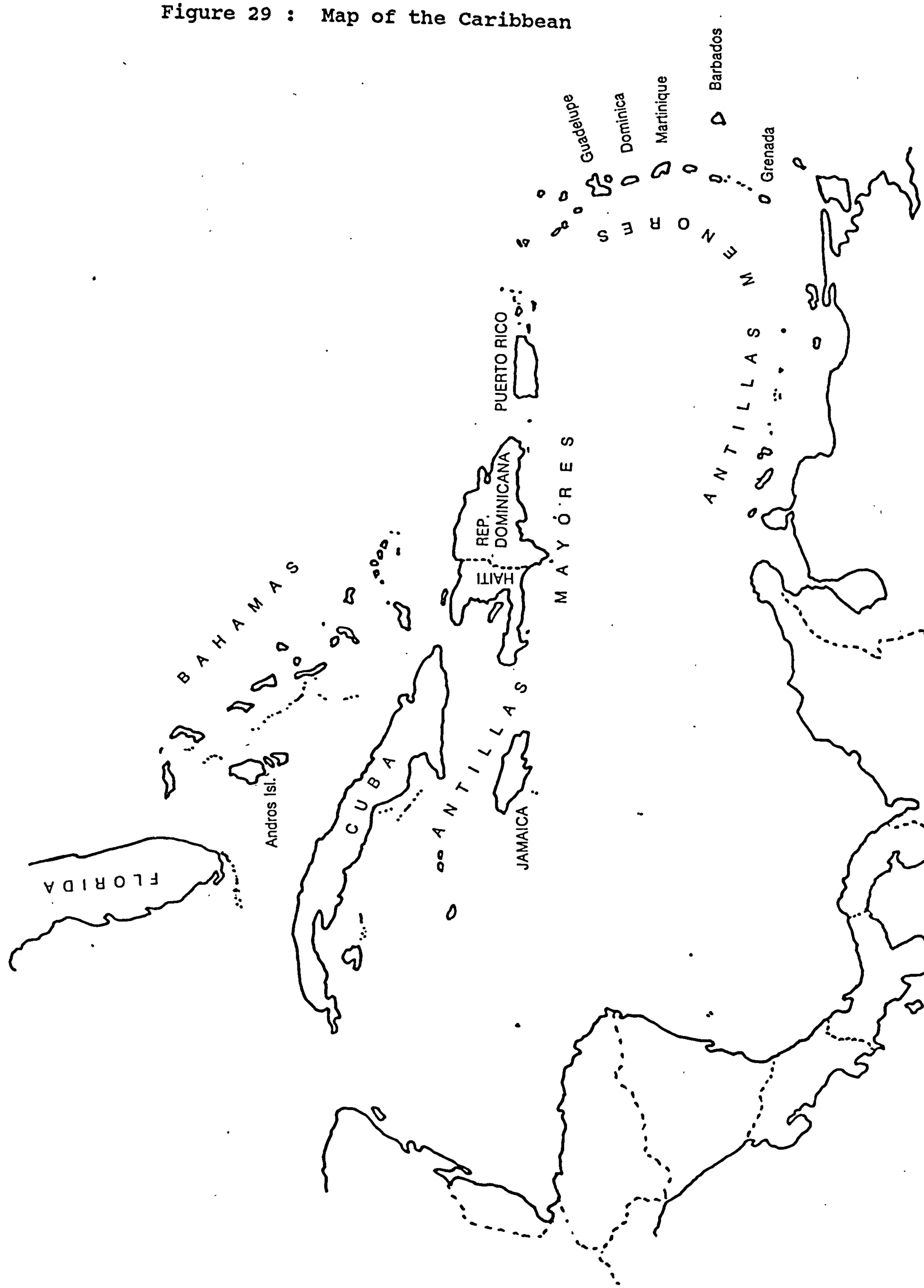
litt.) agreed with me that the taxon does not occur in Brazil. In fact, the southern limit of the distribution of this species is the isle of Antigua.

The West Indies form an archipelago which is more than 2400 km in length, lying between North and South America. The Archipelago stretches in the shape of a crescent from Florida to western Venezuela (figure 29).

Except for the Bahamas which lie further north, all the islands are in tropical latitudes. They enclose the Gulf of Mexico and the Caribbean Sea, which they separate from the Atlantic Ocean on the east.

The West Indies, excluding the Bahamas, are usually referred to as the Antilles. They, in turn are divided into the Greater Antilles, comprising the large islands of Cuba, Jamaica, Hispaniola (Haiti and the Dominican Republic) and Puerto Rico; and the Lesser Antilles, including the small islands forming the Windward and Leeward groups, Barbados, Trinidad and Tobago. The total land area amounts to nearly 240,000 km^2.

Figure 29 : Map of the Caribbean



Cuba is the largest island with about 110,000 km^2; Hispaniola has about 76,000 km^2 (Haiti 27,750; Dominican Republic 48,440) and Jamaica is the third largest with approximately 11,000 km^2.

Many of the smaller islands cover only a few km^2.

Generally, the islands are of high relief and most islands are dominated by a central mountain range with long spurs stretching towards the coast and deep valleys between them. Rivers are accordingly short and swift, and plains are chiefly confined to the coastal regions except in the islands of Cuba, Hispaniola, and Jamaica.

Cuba is the only island with extensive areas of lowland.

Barbados and Antigua are composed largely of coral and such islands as the Bahamas are characterized by lagoons and mangrove swamps.

Nearly all of the lowlands on these islands have been cleared for cultivation and it is subsequently difficult to find primary vegetation. The highest point is the Pico Duarte, a mountain on Hispaniola with an elevation of 3,175 meters.

The West Indian Islands are about 140 million years old and mainly of volcanic origin.

About 10,000 years ago, the mainland was much closer than it is now but it is considered to be certain that no connection above water between the islands and the continent existed in times pertinent to this study.

The climate of the Caribbean is generally tropical. It is characterized by great local variations depending on mountain altitude, water currents and the trade winds. The rainfall va-

ries from 8,900 mm a year in parts of Dominica to only 250 mm a year near the Venezuelan coast.

The region is dominated by the northeastern trade wind with an average velocity of 17 to 35 km per hour. Tropical storms with wind velocities of more than 130 km per hour are seasonally common in the northern parts and almost non-existent in the far south. The hurricanes are most frequent in September with a seasonal average of 8 storms per year.

The vegetation of the Caribbean region is generally tropical but variations in topography, soil consistency, rainfall and humidity have made it diverse.

The porous limestone terraces of the islands are generally nutrient-poor. Near the seashore, black and red mangroves form dense forests around lagoons and estuaries. Coconut palms (Cocos nucifera L.) are typical for the sandy vegetation of the littoral.

On the dry side of each island, succulents and Cactaceae are common.

Rain forests are found on islands with sufficiently high elevations such as Cuba, Jamaica, Hispaniola and Puerto Rico.

Table 9 : Distribution of taxa

	Florida	Bahamas	Cuba	Cayman Islands	Jamaica	Haiti	Dominican Republic	Puerto Rico	Lesser Antilles
Braasiella arizajuliana						×	×		
Hispaniella henekenii						(?)	×		
Olgasis gauntlettii					×				
Olgasis triquetra					×				
Tolumnia bahamensis	×	×							
Tolumnia calochila			(?)	×		(?)	×		
Tolumnia compressicaulis						×	×		
Tolumnia guianensis			(?)			×	×		
Tolumnia haitiensis						×	(?)		
Tolumnia hawkesiana			×						
Tolumnia leiboldii			×	×				(?)	
Tolumnia lemoniana			×						
Tolumnia lucayana		×							
Tolumnia x osmentii							×		
Tolumnia prionochila									×
Tolumnia pulchella					×				
Tolumnia quadrilobia							×		
Tolumnia sasseri		×							
Tolumnia scandens						×			
Tolumnia sylvestris			×						
Tolumnia tetrapetala					×				
Tolumnia tuerckheimii	(?)					×	×		
Tolumnia urophylla									×
Tolumnia usneoides	×								
Tolumnia variegata	×					×	×	×	
Tolumnia velutina	×					×	×	(?)	

Figure: 30 : Map of the Caribbean with distribution of the "Variegata" Oncidiums.

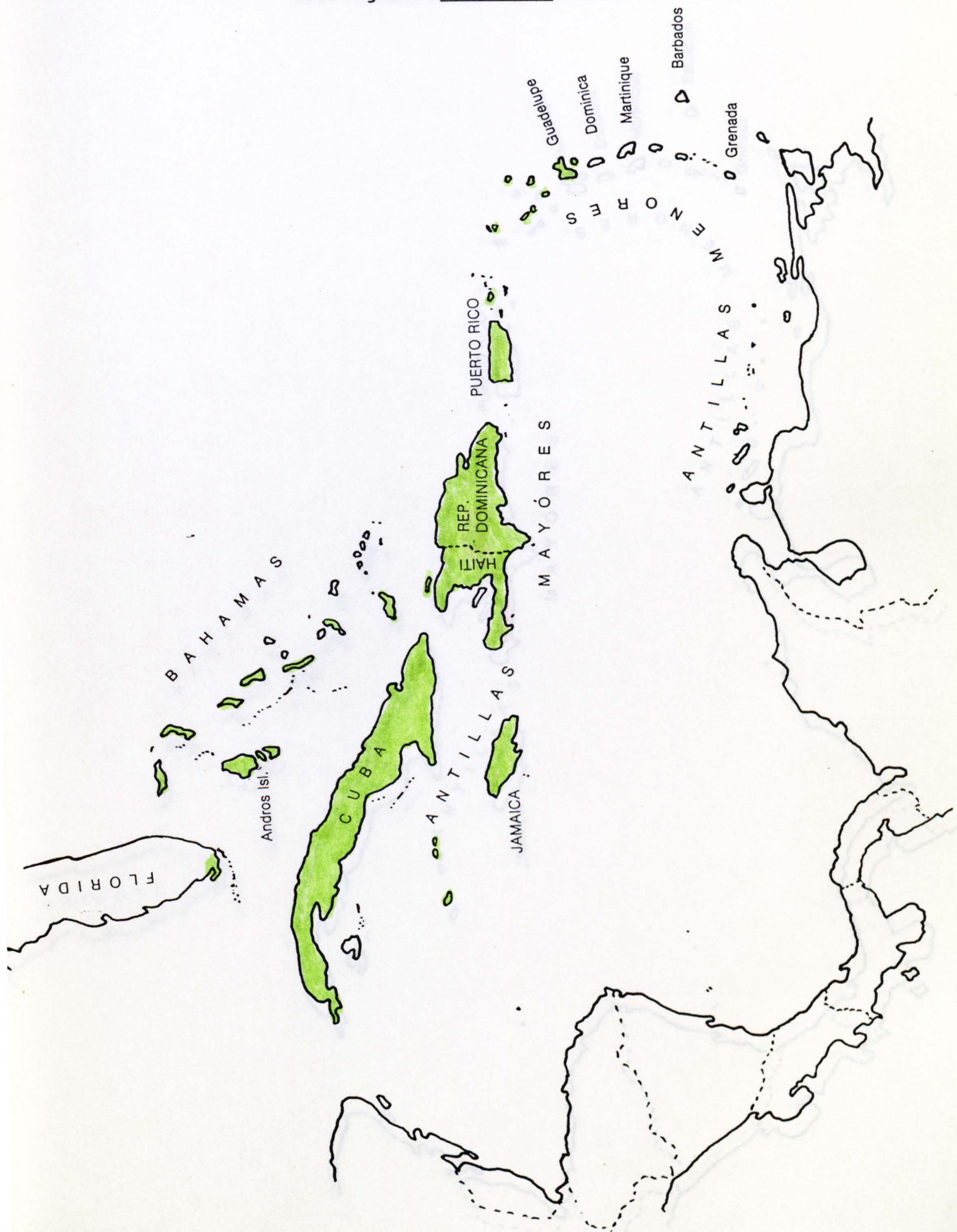


Figure: 31 : Map of the Caribbean with distribution of the genus Braasiella Braem et al.

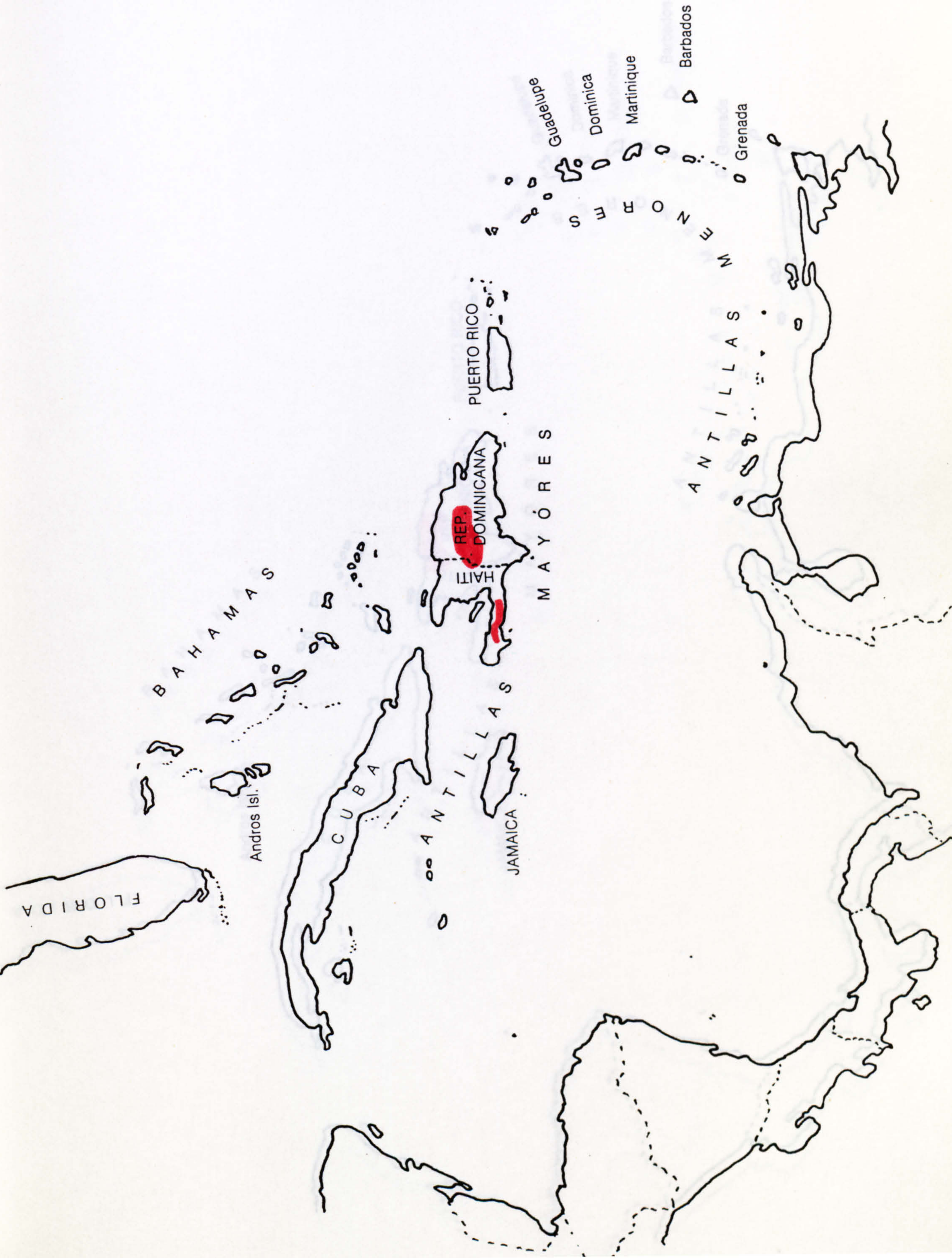


Figure: 32 : Map of the Caribbean with distribution of the genus Hispaniella Braem.

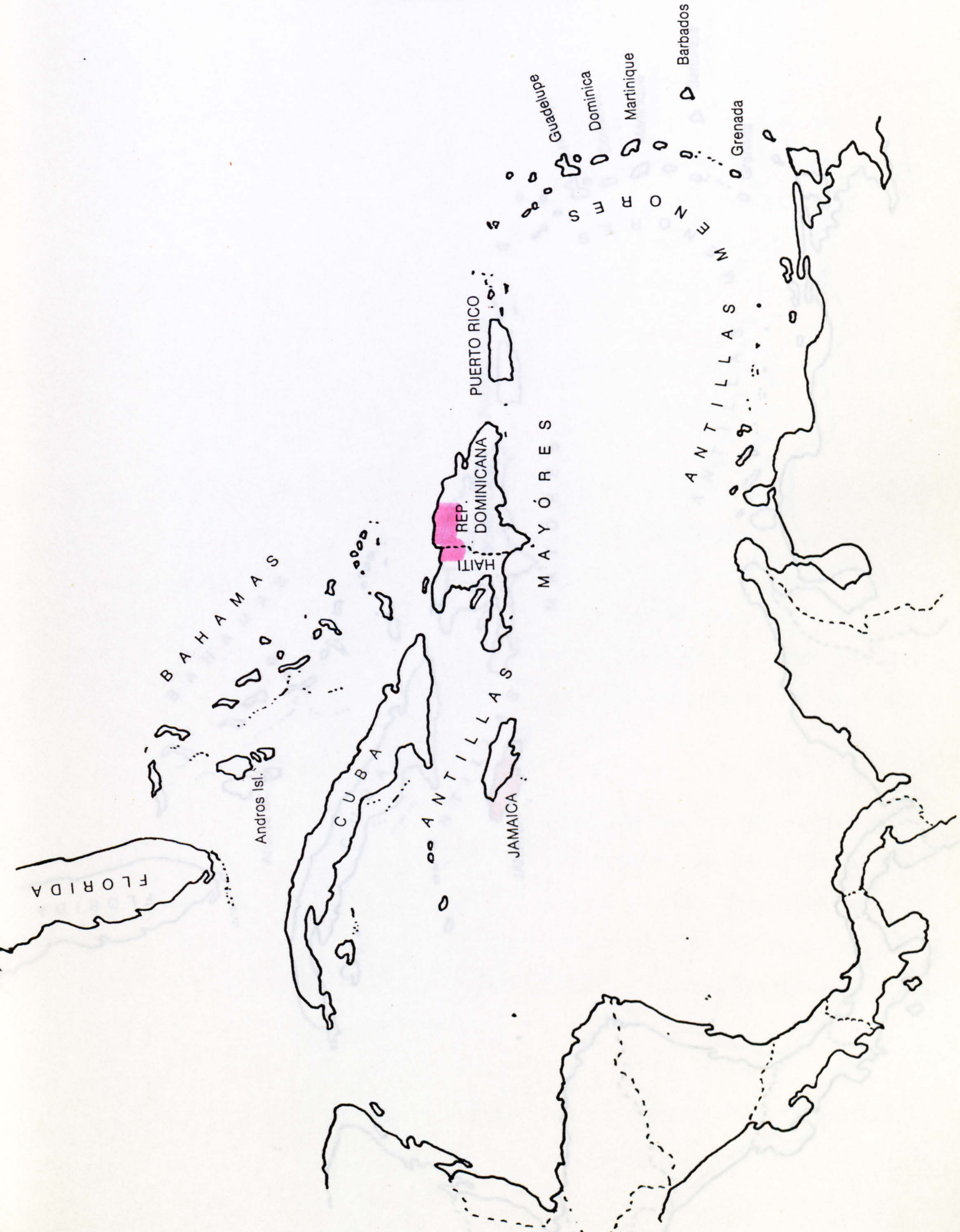


Figure: 33 : Map of the Caribbean with distribution of the genus Olgasis Rafinesque.

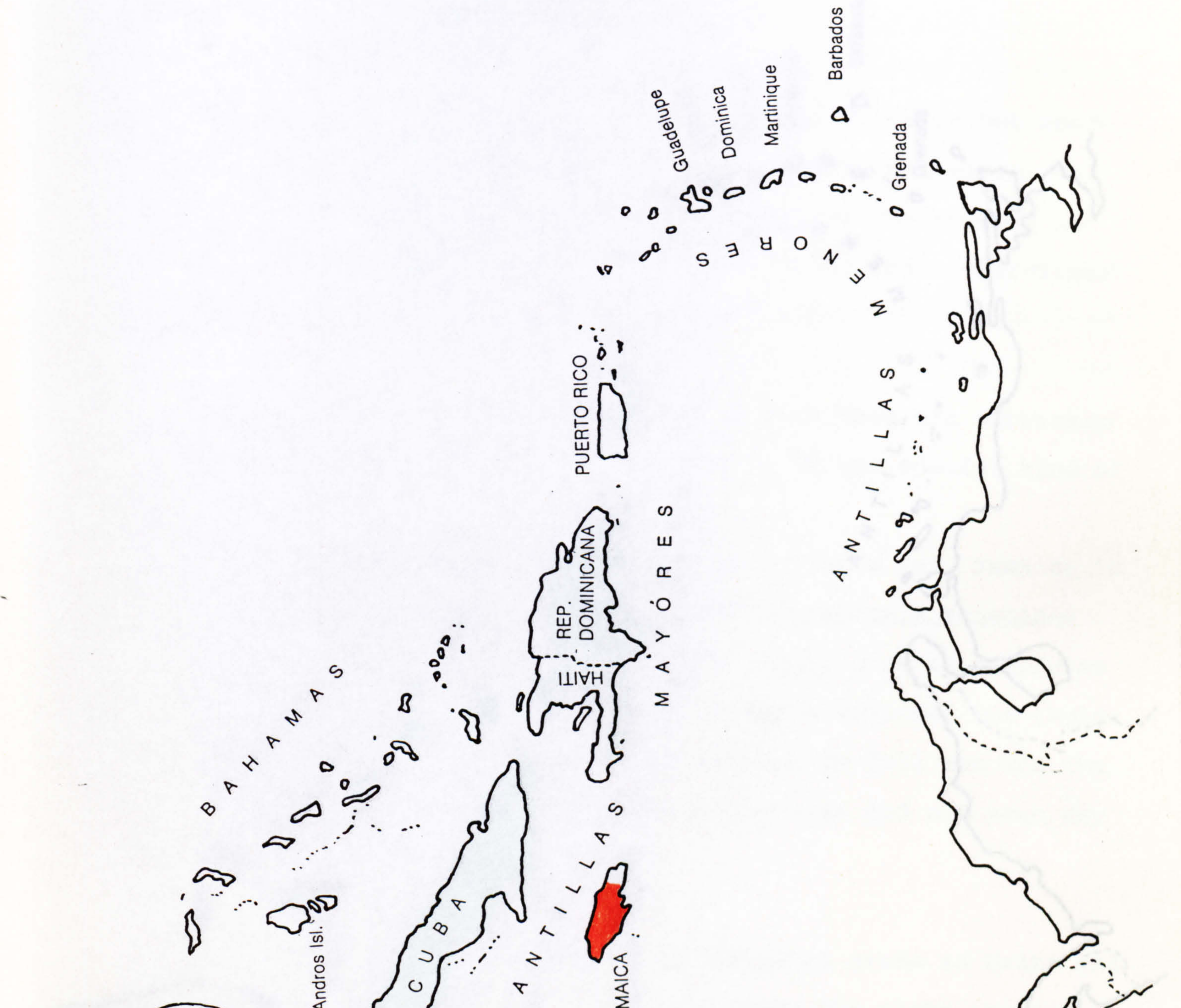


Figure: 34 : Map of the Caribbean with distribution of the genus Tolumnia Rafinesque.

4. 3. 2. 2. ECOLOGICAL OBSERVATIONS

4. 3. 2. 2. 1. GENERAL INFORMATION

Plants of the "Variegata" Oncidiums can be found in hot coastal forests, sometimes only a few meters from the shore, as well as in lowland secondary woods and shrub formations; in cool regions they sometimes even occur up to the timber-line; and in semi-arid and desert-like conditions.

The characteristic of most species is that they are extremely adaptable, although some prefer growing on one special kind of shrub or tree.
I have found Tolumnia tetrapetala, near Hunt's Pen, Jamaica in a thorn-bush vegetation together with Broughtonia sanguinea (Swartz) R. Brown. In that area, the plants grow as epiphytes and flowered abundantly although (or maybe because) the temperature was 45° C. All plants were growing in full sun and the vegetative parts looked dehydrated. The area had not seen any rainfall for over a year.

On the other extreme, Tolumnia tuerckheimii grows in Haiti and the Dominican Republic at altitudes where the night temperature frequently drops below 0° C. The plants therefore have apparently become adapted to grow upside down in order to insure that no water can remain between the leaves, freeze at night and destroy the plant.
When plants of this species are grown "the right side up", their new growths curve downwards indicating that the adapta-

tion is a response to gravity and not merely a function of the growth sites it colonizes.

The "Variegata" Oncidiums seem to have colonized every type of vegetation which can be found on the Caribbean islands. Most of the species grow epiphytically on trees or shrubs, but others (Tolumnia bahamensis, Tolumnia scandens) are said to grow semi-terrestrially. I have observed Tolumnia scandens in its typical habitat in Haiti. The plants seem to germinate on the earth but as soon as they develop roots, they grow epiphytically, colonizing trees by stolons.

4. 3. 2. 2. 2. NATURAL HABITATS

Most of the following information results from personal observations in the field. Some information however is taken from literature or from reliable reports of native orchid collectors. Wherever the information is not from my own observations, it is indicated accordingly.

Braasiella arizajuliana: epiphytic on trees in densely shaded areas along small and medium sized flowing waters. The habitats have a climate with hot humid days and fairly cool nights.
1000 - 1500 meters altitude.

Hispaniella henekenii: epiphytic on thorny bushes in semi-arid areas with extremely high light intensity and daytime temperatures of 45° C. or higher. Night temperatures are around 20 - 25° C. This species often grows together with Tolumnia quadrilobia and Tolumnia variegata.

Olgasis gauntlettii and Olgasis triquetra grow as epiphytes in fairly wet forests. These species seem to prefer growing on Mangifera L., although these trees are not native to the Caribbean. Olgasis-species do not require as much light as other taxa of the "Variegata" and grow often near rivers in deep dark ravines.

Tolumnia bahamensis grows epiphytically on small shrubs in southern Florida and on the Bahamas. These plants

obviously grow best under intense light. They apparently have a particular preference for Ceratiola ericoides Michx. as host (Luer 1972).

Tolumnia calochila is an epiphyte on medium sized to large trees in semi-arid territories not far from the sea-shore. The plants seem to prefer older trees and form little islands of isolated populations in the sense that one never finds neighbouring trees (even of identical kind) bearing the orchid. Tolumnia calochila grows together with Encyclia truncata (Cogniaux) Beckner, Laeliopsis domingensis (Lindley) Lindley and Tolumnia variegata (Sw.) Braem.

Tolumnia compressicaulis grows epiphytically on shrubs in cooler regions from 1000 to 1500 meters altitude. The plants are often hidden between the dense shrub vegetation and are difficult to discover when not in flower.

Tolumnia guianensis: this is a very adaptable species often growing together with Tolumnia variegata in semi-arid areas along the coast as well as on large trees and on shrubs at elevations of up to 700 meters. The colour varieties albo-rubrum and aureo-rubrum were found only in populations growing in semi-arid areas (see below).

Tolumnia haitiensis: this species is said to grow as an epiphyte on small thorny shrubs in the interior parts

of Haiti and the Dominican Republic (D. D. Dod and W. Osment, personal communications).

Tolumnia hawkesiana: no reliable information available. The vegetative habit indicates that this species grows as a twig epiphyte on shrubs.

Tolumnia leiboldii: no reliable information available.

Tolumnia lemoniana: epiphyte in fairly dense forests near sea-shore. (Personal communication from a Botanist of the German Democratic Republic).

Tolumnia lucayana: grows as an epiphyte on small trees (Moir & Moir 1970).

Tolumnia x osmentii is said to grow epiphytically on small shrubs among populations of Tolumnia quadrilobia (W. Osment, personal communication). D. D. Dod, the curator of Orchids at the Moscoso Botanical Garden in Santo Domingo (Dominican Republic) informed me that he had never found any populations of Tolumnia x osmentii growing together with its parent species Tolumnia haitiensis and Tolumnia quadrilobia (D.D. Dod, personal communication).

Tolumnia prionochila: epiphyte on small trees at sea-level, partly in reach of salt-water spray (Moir & Moir 1970).

Tolumnia pulchella is a twig epiphyte on small trees in moist evergreen forests at elevations of 100 - 300 meters. This species requires a fairly warm climate and needs medium to high light intensity. Often to be found on old Citrus paradisi Macf.

Tolumnia quadrilobia: see under Hispaniella henekenii.

Tolumnia sasseri: "On high ground, on trees, up to 6 feet above ground " (Moir 1975).

Tolumnia scandens grows epiphytically on small twigs or in debris in open areas between 1000 and 1600 meters. The plants generally grow in full sun.

Tolumnia sylvestris: no information available. The plants have the same habit as Tolumnia hawkesiana, and may even be conspecific with that species.

Tolumnia tetrapetala: grows like Tolumnia pulchella but generally in dryer and lower habitats. At Southwest Point (Jamaica) the population grows in close vicinity to the sea.

Tolumnia tuerckheimii: grows as an epiphyte on large trees and in moss patches on rocks in altitudes up to 2100 meters. The plants grow upside down (see above).

Tolumnia urophylla: no information available.

Tolumnia usneoides: no information available.

Tolumnia variegata: grows as an epiphyte on shrubs, large and small trees in altitudes of 0 - 1000 meters. This extremely variable and adaptable species is found in arid areas as well as in evergreen forests.

Tolumnia velutina: no reliable information known. Probably as for Tolumnia variegata.

4. 3. 2. 2. 3. POLLINATION

4. 3. 2. 2. 3. 1. INTRODUCTION AND SUMMARY OF PERTINENT LITERATURE

Pollination has been extensively studied in the Orchidaceae (Allen 1951, 1952; Darwin 1862; Dodson 1962, 1965; Dressler 1966; Van der Pijl and Dodson 1966; Vogel 1954, 1966a, 1966b, 1974).

The pollination of orchids is usually carried out by animals, mostly by insects. A considerable number of the striking features of the family is the result of adaptation to animal pollination (van der Pijl and Dodson 1966).

The insects are usually attracted to flowers by advertisement and reward. They are attracted by colour, fragrance and/or morphology of the flower. Thus the pollinator is invited to visit the flower.

Animals however, will not repeatedly visit a flower, when they cannot expect to obtain a reward.

The strategy of most orchids, as far as pollination is concerned, is deceit of various kinds. The pollination animal is lured to the flower by a promise of some kind, mostly an empty one.

Normally orchids signal to the pollinator that it can get food, usually nectar or pollen. In the course of looking for that food, whether it is there or not, the plants are pollinated (food mimicry in the case of deceit).

Sometimes the flowers have a structure similar to those of

another plant which enables them to be visited by the pollinator of the imitated species (Batesian flower mimicry). Other orchids have flowers which look like insects or parts thereof and are pollinated in the course of pseudocopulation or territorial defence (pseudoantagonism).

Because most deceit mechanisms involve mimicry, the pollination of most orchid flowers will be frequency and/or density dependent. To be effective, the mimic should be less often encountered by the pollinator than the model (whether the model is a rewarding flower, potential mate, or potential antagonist).

Whatever method is used, the flower plays the major role and we should therefore not be surprised that the structure and morphology of an orchid flower can indicate by what animal a specific orchid is pollinated, even without ever having seen the actual act of pollination.

For that reason, it is possible to divide the orchids in groups according to the kind of pollinator they use. The sum of pollination specific characteristics of a specific plant is called a POLLINATION SYNDROME.

Table 10. shows the different major pollination syndromes known with the Orchidaceae (after Dressler 1981)

Table 10 : Pollination syndromes associated with different pollinator classes with special reference to orchids (After Dressler 1981).

Characteristics	Bees (feeding)	Euglossine males	Butterflies	Moths	Nectar flies	Carrion flies	Birds
Odors	Sweet, day	Resinous morning	Agreeable, day	Sweet, strong, night	Sweet or disagreeable, day	Foul, day	None
Color	Diverse, including ultraviolet, no pure red	Diverse	Vivid, red, yellow	White, cream, pale green	Green, yellow, brown, red-purple	Dull, brown-purple	Vivid, red, yellow, cerise
Form	Gullet	Diverse	Tubular	Tubular	Cupped, shallow	Cupped or trap	Tubular or narrow cup
Landing platform	+	+/–	+/–	–	+/–	+/–	–
Nectar	+	–	+	+, abundant	+	–	+, abundant
concealed	+/–		+	+	–		+
Nectar guides	+	–	±	–	–	–	–
Other	May have pseudo-pollen				Fringes	Fringes, slots, or windows	

The Oncidiinae show a great diversity of pollination systems. (Dressler 1981). There is bee, butterfly, hummingbird and wasp pollination (van der Pijl & Dodson 1966, Braga 1978).
Most Oncidium species seem to be pollinated by bees and the pollination by male Centris seems to predominate. For Rodriguezia, a close relative of the "Variegata" Oncidiums, pollination by other Euglossine bees has been reported (Dressler 1981) just as pollination by hummingbirds is known in Comparettia, another genus with which the "Variegata" Oncidiums hybridize in the wild.

Little is known about the specific pollination within the "Variegata" Oncidiums. The pollination has actually been observed only in three species(Nierenberg 1972, Dod 1976).
It has been suggested (Dressler, Dod - pers. communication) that most of the "Variegata" Oncidiums are pollinated by Euglossine-bees. On Jamaica, only one single species of this kind of bee is known , but four species of "Variegata" (Tolumnia pulchella, Tolumnia tetrapetala, Olgasis gauntlettii and Olgasis triquetra) are present.

Nierenberg (1972) has described his observations on populations of Tolumnia lucayana and Tolumnia bahamensis. The first are visited by female Centris versicolor (a Euglossine bee) obviously searching for food. The bees leave after a short visit, not having found any food but having pollinated the flowers in the process of searching. They are apparently attracted by the similarity of the yellow flower to that of certain Malpighiaceae (flower mimicry), and attempt to feed off the tabula infrastigmatica (p. 166) which appears to mimic food

bodies (food mimicry).

The male bees of Centris versicolor attack the flowers of the latter species and pollinate them in that process (pseudoantagonism). It is presumed that the hanging flowers of the orchid dancing in the wind mimic "foreign" males to territorial male Centris, which accordingly attack the flowers.

Dod (1976) has observed the pollination of Hispaniella henekenii by a male bee of the species Centris insularis, obviously in the course of pseudocopulation.

Pseudocopulation generally occurs when solitary bee males hatch before females and adopt territories. In the absence of later-hatching females, males are deceived by the odour, shape and texture of the orchid flowers, and attempt to mate with them, thus achieving pollination. Braasiella arizajuliana, like Hispaniella henekenii, has a flower with a highly specialized labellum (figures 2,46) which may suggest that this species also receives pseudocopulatory visits.

It is interesting to note that although "Variegata" Oncidiums may rely on Centris bees alone for pollination, no less than three forms of pollinator attraction are employed, i.e. food mimicry (Tolumnia lucayana), pseudoantagonism (Tolumnia bahamensis), and pseudocopulation (Hispaniella henekenii).

It is particularly noteworthy that the first two, sympatric species, employ different mechanisms with the same pollinator (different sexes), apparently allowing them to coexist although potential pollinators are sparse in diversity.

It is likely that floral diversification in the group has been encouraged by specialization to particular modes of Centris behaviour.

Moir & Moir (1980) claim that moon-phase plays an important role in the pollination of orchids and that the best time to pollinate orchids artificially is the first quarter, i. e. the week before full moon. Thus they write:

"We have written often on the value of the phases of the moon in breeding and how the period when quarterly tides in the ocean are rising are so much better than when tides are falling. .... The second quarter of the moon (the week before full moon) is by far the most promising period to breed."

These indications were checked by Ackerman & Oliver (1985) who studied the pollination of Tolumnia variegata in its natural habitat in the central mountains of Puerto Rico over twice a period of 5 months. They did not find any evidence to substantiate the claim made by Moir & Moir.

4. 3. 2. 2. 3. 2. OBSERVATION ON POLLINATION IN SPECIFIC AREAS

On my travels, I was able to study a few populations more extensively.

The areas studied were:

A. South-West Point (Jamaica) with Tolumnia tetrapetala.

B. Secondary forest near Troy (Jamaica) with Tolumnia pulchella.

C. Open tree formation near Bayahibe (Dominican Republic) with Tolumnia calochila.

D. Dense, secondary vegetation near Bayahibe (Dominican Republic) with Cactaceae and small trees with Tolumnia guianensis and Tolumnia variegata.

E. Arid area densely covered with shrubs near Villa Elisa (Dominican Republic) with Hispaniella henekenii. Tolumnia quadrilobia and Tolumnia variegata.

F. Sub-Montane open vegetation with Tolumnia scandens (Haiti).

G. River Gorge, tributary of Bao River, Dominican Republic, with Braasiella arizajuliana.

In each area, I delimited a quadrat of 10 x 10 meters. All data recorded in table 11 refer to these quadrats.

Table 11 : Observations on reproductive efficiency of "Variegata" in specific areas

Note: For quadrats with more than 100 plants in flower, the average was calculated on 100 randomly chosen flowering plants.

	area	plants per quadrat	plants in flower	% plants in flower	number of flowers per plant	total seed capsules
Braasiella arizajuliana	G	14	2	14	2	1
Hispaniella henekenii	E	17	3	18	1	1
Tolumnia calochila	C	127	96	76	1	19
Tolumnia guianensis	D	249	237	95	17	47
Tolumnia pulchella	B	344	167	49	6	11
Tolumnia quadrilobia	E	4	2	50	2	4
Tolumnia scandens	F	141	103	73	14	24
Tolumnia tetrapetala	A	268	208	78	11	17
Tolumnia variegata	D	73	47	64	13	12
Tolumnia variegata	E	12	3	25	3	4

1. With the exception of Tolumnia quadrilobia (only 4 flowers) no plant was found in which all flowers had been pollinated. Observations were performed between 5:00 and 8:00 AM or, if that was not possible, between 3:00 and 6:00 PM (i.e. for a 3 hour period).

Lots of insects were heard, and some bees and wasps were sighted. On all sites, I did not see any insect carrying pollinia, or visiting a flower.

Noel Gauntlett and Ancille Gloudon who have been collecting "Variegata" on Jamaica for 30 and 17 years respectively, claim to have never seen a pollinating insect on any of the Jamaican species. (Gauntlett and Gloudon, personal communications). Ackerman & Oliver (1985), during their studies on pollination of Tolumnia variegata which lasted a total of 10 months, never saw a pollination event.

2. Hispaniella henekenii is known to be pollinated through pseudocopulation by a male Centris bee (Dod 1976). I have made the observation that the position of the flower of Hispaniella henekenii is different before and after pollination. When pollinia are deposited on the stigmatic surface it closes and the flower surface turns toward the ground. In this way the "insect attracting surface" is hidden. This may remove the mimic signal to the pseudocopulatory male bee after pollination, thus emphasizing the attraction of the unpollinated flowers. In a deceit situation, pollination will be flower-density dependent, and such mechanisms which reduce effective flower density will be favoured.

3. It is interesting that the flowers of Braasiella arizajuliana resemble a certain unnamed wasp in flight.
Although I was able to observe many of the wasps in question during my collecting and counting of the species, I did not observe any of them visiting a flower, neither did I see any with pollinia attached.

4. Upon several occasions during my travels through Hispaniola, I stopped the car, certain that I had discovered a population of Tolumnia guianensis or Tolumnia compressicaulis. On several such occasions the plants proved however to belong to the family Malpighiaceae.
In all regions where I saw those species and in the regions with Tolumnia x osmentii or with Tolumnia quadrilobia I also discovered a yellow flowered Malpighiaceae.
It is possible that flower-mimicry occurs in these species. Nierenberg (1972) has observed Centris versicolor attempting to feed off the tabula infrastigmatica of Tolumnia lucayana which resembles the food bodies of certain Malpighiaceae.

5. Tolumnia guianensis and Tolumnia variegata grow in arid habitats as well as in non-arid areas. The plants growing in the arid habitats generate shorter inflorescences with fewer flowers than those growing in the wetter regions.

Pollination techniques of the "Variegata"

There is no evidence whatsoever that the "Variegata" offer any kind of reward. None of the species have a noticeable fragrance. None of the species discussed here are known to be au-

togamous (automatically self-pollinating within a flower in the absence of an insect visit).

In culture it was possible to successfully pollinate and fertilize some of the species geitonogamously. It was, for example, possible to artificially self Tolumnia pulchella, Tolumnia tetrapetala, Tolumnia urophylla and Olgasis triquetra. Selfing was however never successful with Tolumnia calochila and Tolumnia guianensis. Thus, these two species may be self-incompatible. For the other species, no data about this phenomenon is available.

For most species only one, or only a few flowers open at the same time. Thus, most fertilization will result from cross-pollination, even if the species is self-compatible, as is the case for the first four. I presume that all species are primarily outbred, although some limited geitonogamous selfing may also occur in some.

Main mechanism : DECEIT

a) Pseudocopulation

Braasiella arizajuliana (?)
Hispaniella henekenii

b) Aggression

Tolumnia bahamensis

c) Food mimicry
(Mimicry of Malpighiaceae-flowers)

Tolumnia compressicaulis (?)
Tolumnia guianensis (?)
Tolumnia lucayana (see p. 166)
Tolumnia x osmentii (?)
Tolumnia quadrilobia (?)
other species ? (see p. 166)

4. 3. 2. 2. 3. 3. DISCUSSION

Little is known about the pollinators of the "Variegata". The studies of Nierenberg (1972) on Tolumnia bahamensis and Tolumnia lucayana as well as the observations of the actual pollination of Hispaniella henekenii by a male Centris-bee (Dod 1976) are exceptional.

However, the studies of Nierenberg indicate that most "Variegata" are pollinated by Centris, whereby the male bees pollinate the white to lilac coloured flowers in the act of defending their territory (PSEUDOANTAGONISM) and the females pollinate the other coloured flowers in the course of their search for food (FOOD MIMICRY or FLOWER MIMICRY)

One species (Hispaniella henekenii) is pollinated in the act of PSEUDOCOPULATION and I suggest that Braasiella arizajuliana is pollinated either in the process of pseudocopulation or pseudoantagonism.

Species growing in arid as well as in non-arid habitats make shorter inflorescences in the arid habitats with fewer flowers than those individuals growing in the less arid habitats, as observed in Tolumnia guianensis and Tolumnia variegata.

My observations indicate that only few flowers of an inflorescence are pollinated. The generation of each seed pod costs the plant much energy, and the continuity of the individual is secured by the enormous amount of seeds in a single orchid seed pod. It is therefore possible that the percentage of pollination measured on the basis of total flowers available is higher in the arid regions (higher pollination efficiency in

stressed habitats). However, few pods are produced per plant (table 11), because few flowers are available.

In the Orchidaceae, a number of mechanisms with which a multiflowered plant assures that only one or few flowers are pollinated have been described (Dressler 1981). For Hispaniella henekenii this mechanism is known (see above) although fruit-set is observed at 33 % (table 11). For all other species within the group, no indication of any such mechanism is available. However, the data presented in table 11 indicates that fruit-set is often low in the "Variegata", and for 5 species (half of the samples) may rarely exceed 2 %. It is unlikely that fruit-set in any "Variegata" often exceeds 50 %. As a result, the number of fertile pods borne by a given individual rarely exceeds one (table 11).

Resource allocation theory (e.g. Charnov 1982) might predict that such small outbreeding plants with large expensive seed-pods should show low fruit-set efficiency through inefficient pollination, or pod abortion, so that female function can be fully realized.

Although deceit pollination mechanisms will be most efficient at low flower density, in self fertile species, several flowers per genet may need to flower at the same time for efficient geitonogamous pollination to occur.

4. 4. MORPHOLOGY

4. 4. 1. VEGETATIVE MORPHOLOGY

The vegetative morphology of the "Variegata" shows a few interesting features. Some of these are unique to this group of orchids and were included in Swartz's generic description of Oncidium (Swartz 1800), although not all of his five Oncidium species possess them, and they do not occur in Oncidium sensu Braem.

Up to a few years ago, the "Variegata" were generally characterized as small plants with fans of distichous, triquete leaves; without pseudobulbs.

Although the "Variegata" include species whose vegetative characteristics do correspond to that description, it is definitely not valid for all species of the group.

A. There are several different forms of leaf-sections.

1. triquetrous eg. Olgasis triquetra
   Hispaniella henekenii
   Tolumnia variegata
   Tolumnia lemoniana ssp. lemoniana
2. semi-terete eg. Tolumnia bahamensis
3. terete eg. Tolumnia calochila

Tolumnia lemoniana ssp. guibertiana

4. other eg. Braasiella arizajuliana

B. Most species have distichous leaves, but Braasiella arizajuliana has not.

C. Some species do have pseudobulbs (eg. Tolumnia compressicaulis), others do not (eg. Hispaniella henekenii).

D. Some species are stoloniferous (Tolumnia subgenus Variegata Braem), others are not (Tolumnia subgenus Tolumnia, Braasiella, Hispaniella, Olgasis) (see Figure 6).

E. Two species (Tolumnia prionochila and Tolumnia urophylla) produce adventitious [1] plantlets at the internodes of the inflorescence (see Figure 35).

All vegetatively important characteristics are shown in table 12.

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(1) Adventitious plantlets from the inflorescence are known from a number of orchid genera. They are usually referred to as "Keikis".

Figure 35 : Adventitious plantlet at the internode of an inflorescence of Tolumnia prionochila (Kränzlin) Braem

Table 12 : Vegetative characteristics of the "Variegata"
(Characters 1-6 for data scoring, see p. 233

	LEAF FORM (2)	DISTICHOUS LEAVES Y/N	PSEUDO-BULBS Y/N	STOLONS Y/N	"KEIKIS" Y/N	GROWTH UPSIDE DOWN Y/N
B. arizajul.	4	N	Y	N	N	N
H. henekenii	1	Y	N	N	N	N
O. gauntlettii	1	Y	N	N	N	N
O. triquetra	1	Y	N	N	N	N
T. bahamensis	2	Y	N	Y	N	N
T. calochila	3	Y	N	N	N	N
T. compressic.	1	Y	Y	N	N	N
T. guianensis	1	Y	N	N	N	N
T. gui. albor.	1	Y	N	N	N	N
T. haitiensis	1	Y	N	N	N	N
T. hawkesiana	1	Y	N	Y	N	N
T. leiboldii	1	Y	N	N	N	N
T. lemoniana ssp. lemon.	1	Y	N	N	N	N
T. lemoniana ssp. guib.	3	Y	N	N	N	N
T. lucayana	1	Y	N	N	N	N
T. x osmentii	1	Y	Y	N	N	N
T. prionochila	1	Y	N	N	Y	N
T. pulchella	1	Y	N	N	N	N
T. quadrilobia	1	Y	Y	N	N	N
T. sasseri	1	Y	N	Y	N	N
T. scandens	1	Y	N	Y	N	N
T. sylvestris	1	Y	N	Y	N	N
T. tetrapetala	1	Y	N	N	N	N
T. tuerckheim.	4	Y	N	N	N	Y
T. urophylla	1	Y	Y	Y	Y	N
T. usneoides	1	Y	N	N	N	N
T. variegata	1	Y	N	Y	N	N
T. velutina	1	Y	N	Y	N	N

(2) 1 = triquetrous in section
2 = semi-terete in section
3 = terete in section
4 = other in section

4. 4. 2. FLORAL MORPHOLOGY

4. 4. 2. 1. INFLORESCENCE

All plants of the "Variegata" have one (seldom two) lateral inflorescence(s) carrying few to many flowers. Some species differ in their number of flowers depending on the climatic characteristics of the growing area. Tolumnia variegata has multiflowered inflorescences in the dense secondary vegetation area near Bayahibe (Dominican Republic) but shows much shorter inflorescences with only one or at the most 2 or 3 flowers in the extremely dry, shrub vegetation near Villa Elisa (Dominican Republic).

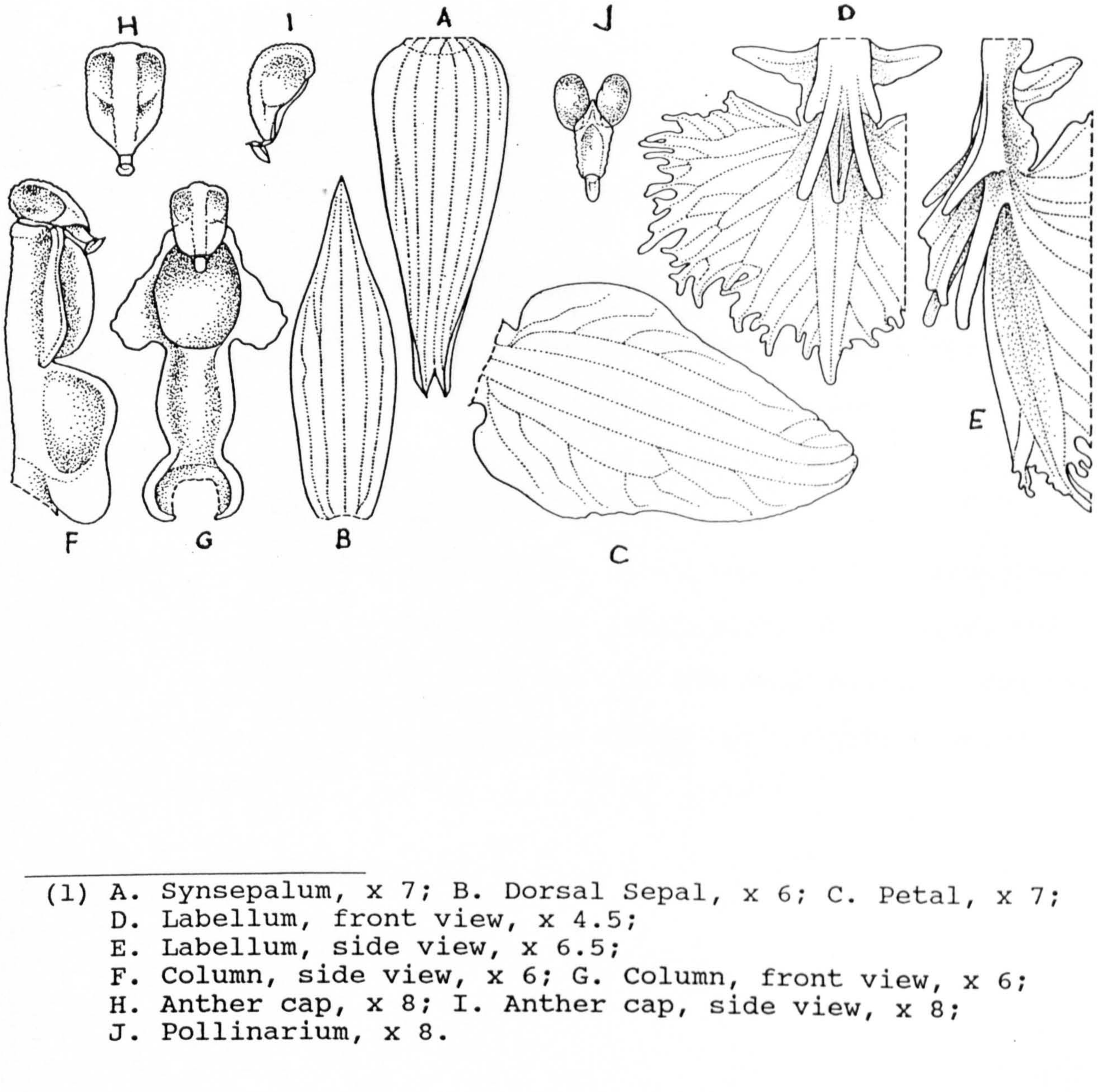
The peduncle of the "Variegata" is terete over its full length in all species but one. Tolumnia compressicaulis has a inflorescence which is laterally flattened at the base at the base, a feature referred to in the name.

4. 4. 2. 2. FLOWER MORPHOLOGY

4. 4. 2. 2. 1. INTRODUCTION

Like all orchid flowers with one single fertile anther, the flowers of the "Variegata" have 3 sepals, 3 petals and a column.

Figure 36 : Drawing of floral structure of Tolumnia calochila (Cogniaux) Braem [1] [Drawing by Joanna Langhorn]



(1) A. Synsepalum, x 7; B. Dorsal Sepal, x 6; C. Petal, x 7;
D. Labellum, front view, x 4.5;
E. Labellum, side view, x 6.5;
F. Column, side view, x 6; G. Column, front view, x 6;
H. Anther cap, x 8; I. Anther cap, side view, x 8;
J. Pollinarium, x 8.

As in all orchids, the ovary is inferior and as in most epiphytic orchids, the ovary is not fully differentiated at flowering time. Its development is only continued when the flower is pollinated, a feature saving the plants a lot of energy.

As for all Oncidiinae the flowers of all "Variegata" species are resupinate, which means that the lip is positioned on the lower side of the orchid flower.

4. 4. 2. 2. 2. OVERALL MORPHOLOGY

The overall morphology of the flower is not always invariable within species belonging to the "Variegata". Although most species are relatively stable in their flower morphology, form and/or size vary considerably in other species.
The species with variable flower morphology are:

Braasiella arizajuliana (Fig. 37)
Tolumnia bahamensis
Tolumnia pulchella (Fig. 38)
Tolumnia scandens
Tolumnia tetrapetala (Fig. 39)
Tolumnia variegata (Fig. 40)
Tolumnia velutina

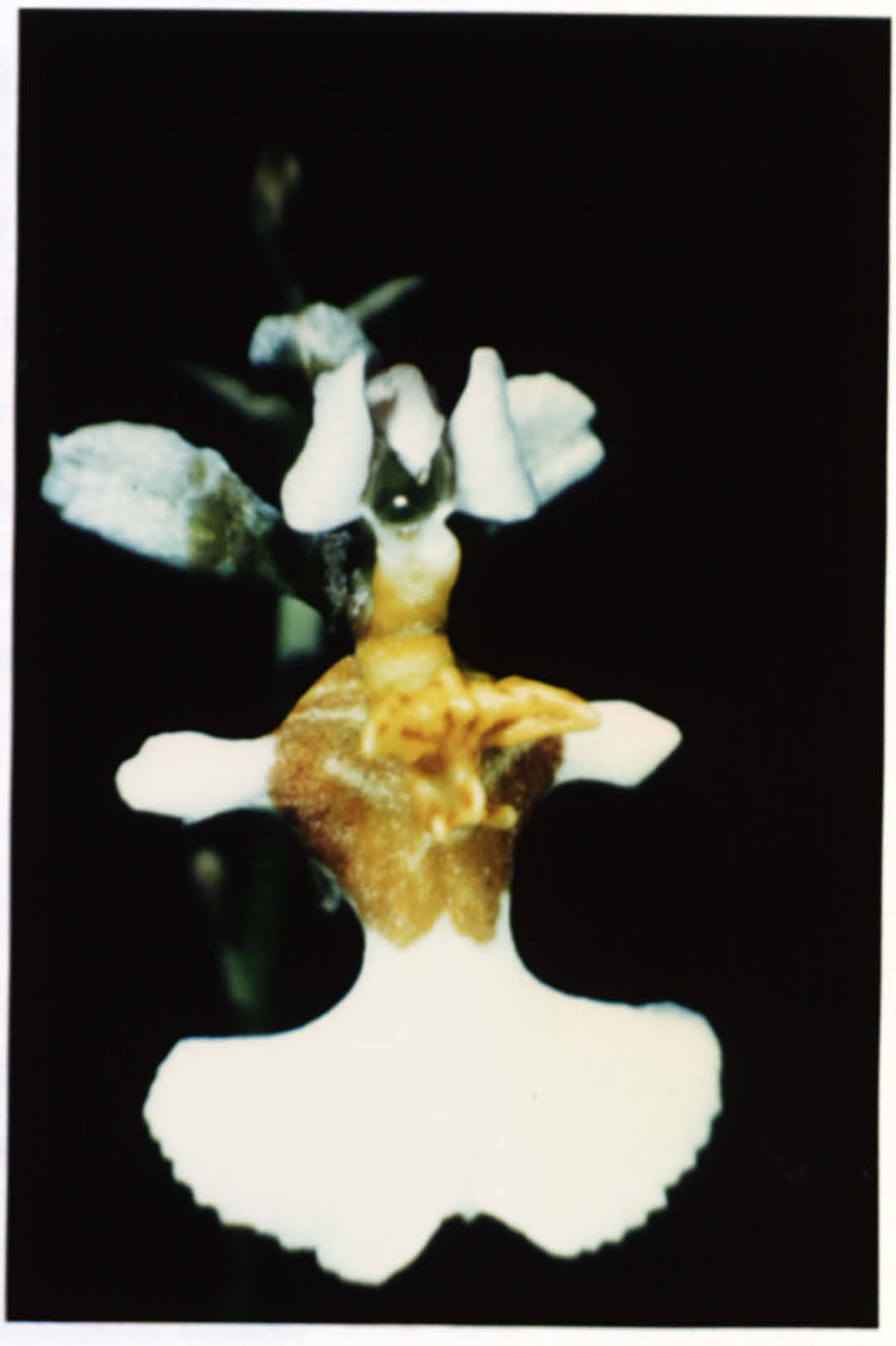
The reasons for these variations are not very clear; on one hand there may not yet be complete speciation or different levels of stabilizing selection may occur with respect to pollination; on the other hand the variation could be caused by interbreeding of species in the wild.
Withner & Stevenson (1968) have discussed the interbreeding of Tolumnia pulchella and Tolumnia tetrapetala on Jamaica, and although no areas are known today where both species grow sympatrically, it is quite possible that hybridization occurred in the past.

Figure 37 : Variation in Braasiella arizajuliana (Withner & Jimenez) Braem.

Figure 38 : Variation in Tolumnia pulchella (Hooker) Rafinesque.

Figure 39 : Variation in Tolumnia tetrapetala (Jacquin) Braem.

Figure 40 : Variation in Tolumnia variegata (Swartz) Braem.



4. 4. 2. 2. 3. FLOWER COLOUR

The species of the genera Braasiella, Hispaniella and Olgasis are relatively stable in floral coloration. In general, the varieties in colour are mere nuances.

The same can be said about a number of species within the genus Tolumnia. Other species of that genus show a certain variation in the shade of flower colour, mostly between white and more or less deep purple (figures 37-40).

Tolumnia guianensis and Tolumnia lucayana are two species which are definitely variable in colour (figures 41,42) and a number of varieties are known and have been described, sometimes even as autonomous species.

A number of species belonging to the "Variegata" (Tolumnia calochila, Tolumnia compressicaulis, Tolumnia guianensis, Tolumnia haitiensis, Tolumnia lemoniana, Tolumnia lucayana var.aurea, Tolumnia prionochila, Tolumnia quadrilobia, Tolumnia tuerckheimii and Tolumnia urophylla) and the natural hybrid Tolumnia x osmentii have yellow as the basic flower colour. I have observed that in the vicinity of all sites where I have discovered yellow flowered "Variegata", I could also find a yellow flowering species of Malpighiaceae.

I therefore believe that the yellow flower colour of a "Variegata" species indicates a Malpighiaceae mimic.

Table 13 : Variability in floral colouration within the "Variegata".

	STABLE	VARIABLE IN SHADE	VARIABLE IN COLOUR
B. arizajuliana		*	
H. henekenii	*		
O. gauntlettii		*	
O. triquetra		*	
T. bahamensis		*	
T. calochila	*		
T. compressicaulis	*		
T. guianensis			*
T. haitiensis	*		
T. hawkesiana		*	
T. leiboldii		*	
T. lemoniana	*		
T. lucayana			*
T. x osmentii	*		
T. prionochila	*		
T. pulchella		*	
T. quadrilobia	*		
T. sasseri		*	
T. scandens		*	
T. sylvestris		*	
T. tetrapetala		*	
T. tuerckheimii	*		
T. urophylla	*		
T. usneoides	* (?)	* (?)	
T. variegata		*	
T. velutina		*	

From Tolumnia guianensis four colour varieties have been described:

a. unicoloured yellow type (Figure 41 top)

b. var. alborubrum (Figure 41 bottom left)

c. var. aureorubrum (Figure 41 bottom right)

d. var. alba

Figure 41 : Colour varieties of Tolumnia guianensis (Aublet) Braem.

Within the varieties alborubrum and aureorubrum there is a differentiation of colouration of the labellum generated by the difference in areas of red pigmentation. Withner (1976) interprets this variation within the varieties as genetic distinctions within one species, as he sees no related species that could be involved in interbreeding resulting in such different characteristics.

In contrast, my study of the natural populations has shown that Tolumnia guianensis var. alborubrum and Tolumnia guianensis var. aureorubrum only occur in those populations where Tolumnia guianensis grows sympatrically with Tolumnia variegata. In those mixed populations, both species flower at the same time.

I consider it possible therefore that Tolumnia guianensis var. alborubrum is a natural hybrid between Tolumnia guianensis and Tolumnia variegata. Tolumnia guianensis var. aureorubrum could then be the result of a natural backcrossing with the "normal" pure yellow form of Tolumnia guianensis. This should mean that more plants of var. alborubrum than var. aureorubrum occur, and indeed, I have found a total of 14 plants of var. alborubrum and 5 plants of var. aureorubrum. These 19 plants were found in 2 single locations, quite a distance from each other. Both locations had both "normal" Tolumnia guianensis and Tolumnia variegata present as well as both varieties.

However, several features argue against this hypothesis. First there is the fact that Tolumnia variegata is stoloniferous, a characteristic which tends to be fairly dominant in other hybrids with that species, whereas all varieties of Tolumnia

guianensis are non-stoloniferous, like the type of that species.

Secondly, Nierenberg (1972) has observed, that although two sympatrically growing "Variegata" can be pollinated by the same species of bee, usually one plant species is pollinated by the male and the other by the female.

Although Nierenberg's studies were performed on the Bahamas and in Florida with different species, a similar pattern in the Bayahibe region is obvious. Tolumnia guianensis appears to imitate a yellow coloured Malpighiaceae-flower and therefore is most probably pollinated by a female bee of Centris versicolor searching for food, whereas Tolumnia variegata (a close relative to Tolumnia bahamensis studied by Nierenberg) is possibly pollinated by the male bee defending its territory. If this is correct, then hybridization between the two species is unlikely.

Tolumnia lucayana was studied by Withner on the Bahamas (Withner 1976). He studied populations on 3 islands and found one form with small white and purple flowers with a pointed, anchor-shaped labellum and another form with a larger, yellow coloured flower spotted brown or maroon, with a retuse lip. Three varieties of Tolumnia lucayana [var. aureum (Figure 42), var. purpureum and var. rubiginosum] have been described (Moir 1973), and an orange-red flowered plant, described as Oncidium lyratum (Withner 1967) can obviously be considered as a fourth colour variety of Tolumnia lucayana. (see above).

Figure 42 : Tolumnia lucayana var. aurea

I conclude that flower size and flower colour must be used with care as a systematic marker within the "Variegata". The first flowers are usually larger than those which are developed later. In species with branched inflorescences, the flowers at the end of the branches are usually smaller than those near the main peduncle. Flower size is also variable according to geographical areas. Populations from higher elevations may (although this should not be generalized) generate smaller flowers.

Flower colour varies within limits in nearly all species of the "Variegata", as a result of different light intensities.

4. 4. 2. 2. 4. PERIANTH MORPHOLOGY

The perianth of the flowers of the "Variegata" is built up out of 3 outer segments, usually called sepals and 3 inner segments, usually called petals.

In a large number of orchid species, we find that the two lateral sepals are partly or completely united to a single structure referred to as Synsepalum.(see Figures 36a, 43a).

Of all "Variegata" species, only Braasiella arizajuliana does not have its lateral sepals united (Figure 43b). This major feature argues for the position of the species in a unitypic genus.

Figure 43 : Presence (left) or absence (right) of a synsepalum.

In the Orchidaceae the median petal (the one opposite the fertile anther) is virtually always differentiated from the other two in form, and sometimes also in colour. This differentiated petal is generally referred to as the lip or as the labellum (labium in old litt.) and is usually larger and more complex than all other perianth segments.
Analogously, all "Variegata" have such a labellum (see Figure 36d).

The labellum of all species within the "Variegata" is trilobate. In a number of species, the apical lobe is distinctly indented at the apex so that some authors refer to the labellum as quadrilobed. Usually the lateral lobes are less than half the area of the apical lobe.

One species Tolumnia quadrilobia and its natural hybrid with Tolumnia haitiensis - Tolumnia x osmentii - differ from all others in that the lateral lobes of the lip are half the area of the apical lobe, or nearly so (Figures 16,28).
Tolumnia guianense and Tolumnia usneoides differ from all other species in that they have lateral petals which are similar in area and colour to the labellum (Figures 10,19,41).

One of the main features of the labellum within the Oncidiinae is the callus on the basis of the labellum. This callus is one of the main characteristics used by Swartz in his generic description of the genus Oncidium (Swartz 1800) (see table 4). It is indeed obvious that Swartz considered this to be a very important feature and therefore one must follow Rafinesque (1837) who separated Oncidium triquetrum and created the genus Olgasis for this species which has no callus.

There are two other species of the group of plants discussed here which have no callus. One, Olgasis gauntlettii, is obviously a close relative of Olgasis triquetra and like this species is a Jamaican endemic. I transferred this species from Oncidium to Olgasis accordingly (Braem 1982).

The other, Hispaniella henekenii has a unique flower morphology compared to all other species. Therefore I transferred this species to the monospecific genus Hispaniella (Braem 1980b).

Figure 44 : Presence (a) or absence (b,c) of basal callus on the labellum

a) Top left: Tolumnia variegata.
b) Top right: Olgasis triquetra. Bottom: Hispaniella henekenii

The callus, present in all species of the genera Braasiella and Tolumnia, is more or less similar in all but three taxa. Tolumnia calochila, Tolumnia haitiensis and Tolumnia x osmentii have a callus with fingerlike protrusions differing from all other species (figure 45).

Figure 45 : Structure of the callus in the "Variegata".

Left: Tolumnia variegata

Right: Tolumnia haitiensis with fingerlike protrusions (see p. 162)

4. 4. 2. 2. 5. THE COLUMN AND ASSOCIATED STRUCTURES

4. 4. 2. 2. 5. 1. INTRODUCTION

In all orchids the style and the staminal filaments are at least partly united. In most cases, including the Oncidiinae, those structures are completely united and cannot be distinguished.

This combined structure is called the column or gynostegium. This column in the genus Oncidium and its relatives, including the "Variegata" is rather obvious and winged (see Figure 36 f,g).

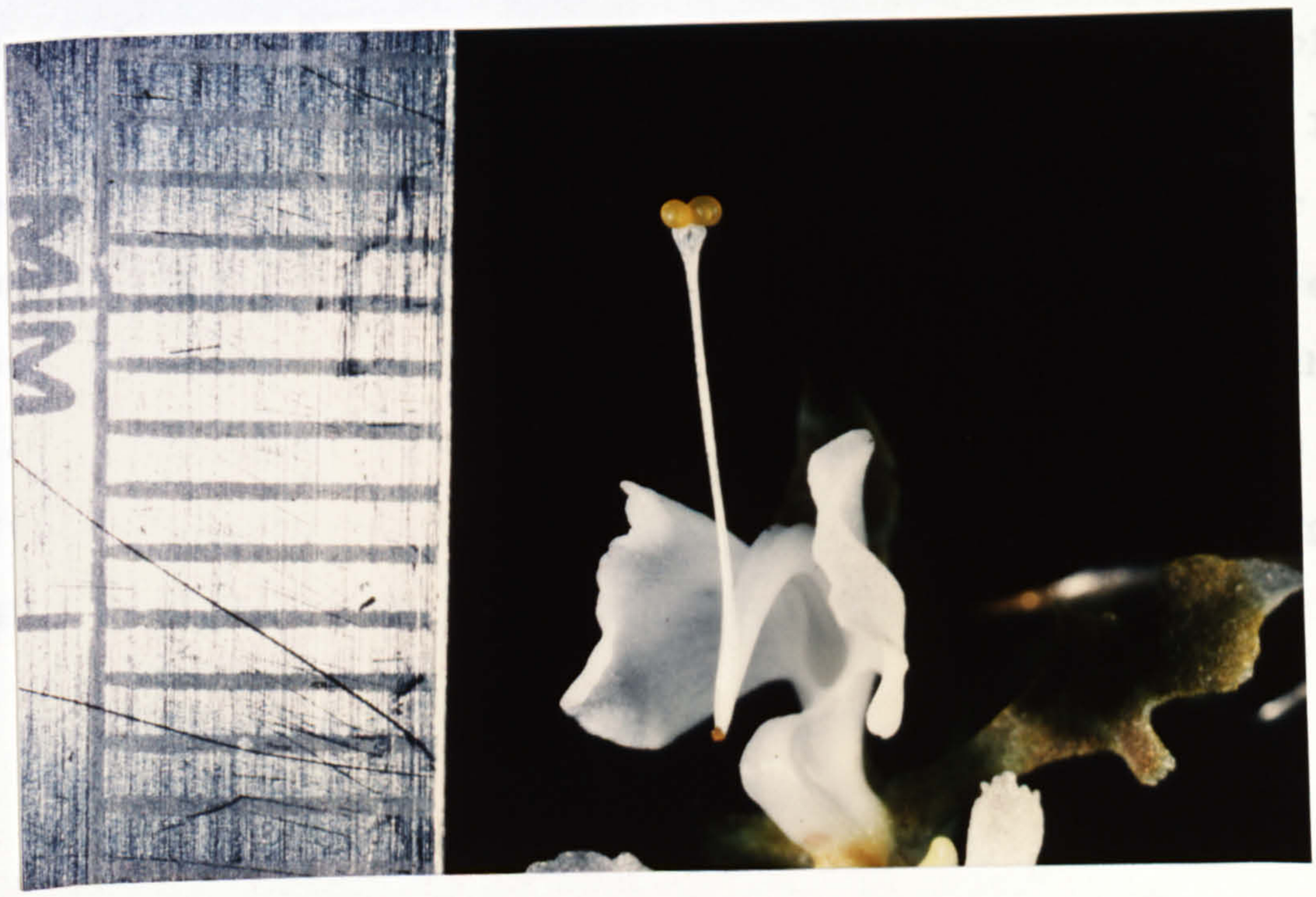
These column wings are frequently interpreted as sterile stamens (staminodia) (Dressler 1981). In Braasiella arizajuliana (Withner & Jimenez) Braem et al., they are enormous compared to those of all other species within the "Variegata" (see figure 46, top right). The column wings differ in size and are specific enough to warrant their use as a taxonomic marker at the generic level.

The typical column structure for the "Variegata" is shown in fig 36. Within the group of orchids discussed here, there is little variation in column structure.

Usually the anther is seated in a clearly defined area at or near the apex of the column. Only Braasiella arizajuliana differs from all other "Variegata" in the structure of the anther in that it shows a prolonged structure to accommodate the long stipe (see figure 46 top left and bottom).

Figure 46 : Floral aspects of Braasiella arizajuliana.

Top left: Overview of the flower. (x4)
Top right: Sideview showing enormous column wings. (x4)
Bottom: Front view of the top part of the flower showing the beak-like elongated anther and the typical characteristic pollinarium with the prolonged stipe and the relatively small spheroid pollinia. (x5)



4. 4. 2. 2. 5. 2. TABULA INFRASTIGMATICA

Within the Oncidiinae and therefore also within the "Variegata" we find a pad of tissue on the base of the column (Figure 47). This structure, which may be part of the labellum (Dressler 1981) is often distinctive in colour and texture and seems to have a function in the pollination process. It has been suggested (Dressler 1981) that anthophorid bees hold on to this structure with their mandibles while gathering oil with their legs (for those Oncidiums, outside this work, which are so pollinated).

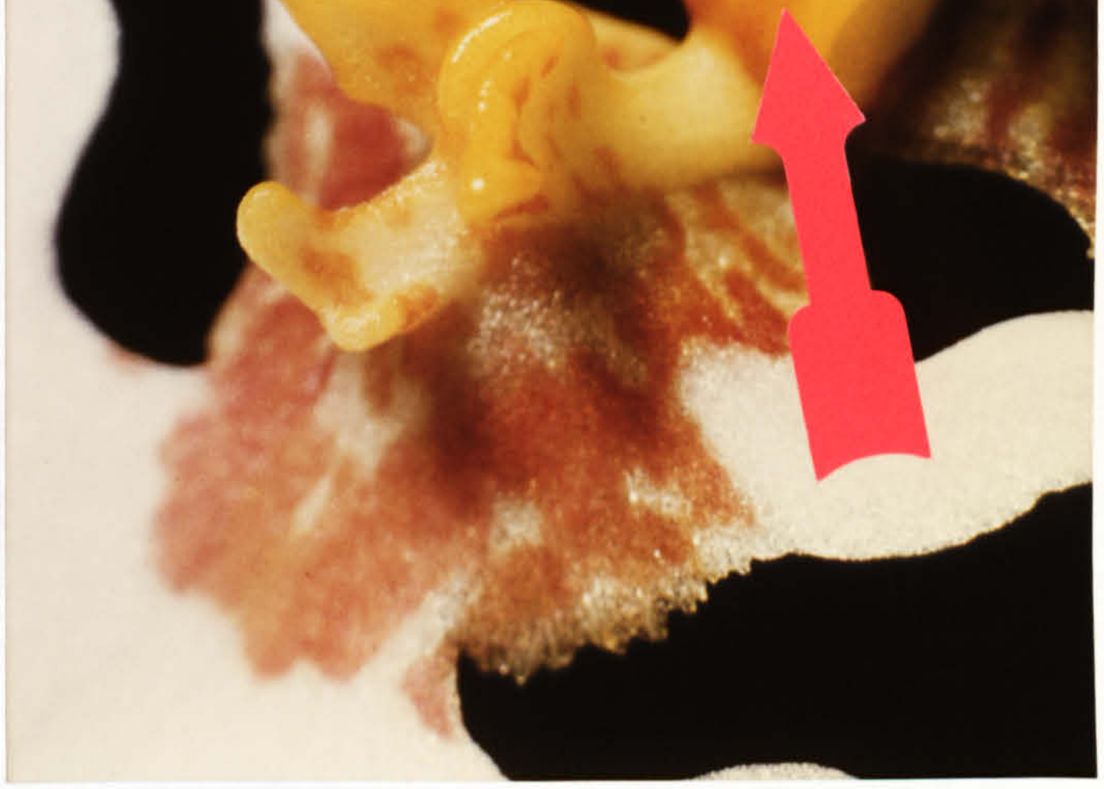
In Haiti, Nierenberg (1972) has observed female Centris versicolor working flowers of Malpighiaceae in an area where Tolumnia guianensis (Aublet) Braem is found.

He observed how the bees grasp the thickened claw of the fifth petal with their mandibles. On the Bahamas, Nierenberg observed that bees follow a similar behaviour pattern on Tolumnia lucayana. There the bee landed on the central part (the callus) and grasped the infrastigmatic lobe with its mandibles and started to search for food as in the Malpighiaceae. In the Dominican Republic, Nierenberg reports observing similar action of a bee (probably a female Centris but not positively identified) on a flower of Tolumnia quadrilobia. Thus, the tabula infrastigmatica appears to act as a food-body mimic as part of the putative flower-mimicry of yellow flowered Tolumnias with certain Malpighiaceae.(see page 128).

Fig. 47 : Tabula infrastigmatica

Left: Olgasis triquetra

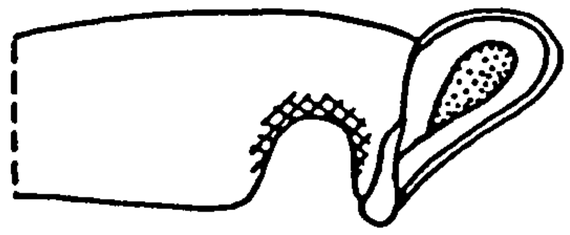
Right: Tolumnia variegata



4. 4. 2. 2. 5. 3. ANTHER

The anther of the Orchidaceae is basically an oblong structure with four longitudinal sporebearing sacs.
The attachment of the anther is a feature of some characteristic importance at the tribal level. In most Vandoideae, the anther is lightly attached to a short filament and is readily deciduous.
The position of the anther has been used to differentiate between advanced and primitive groups within the Orchidaceae. In the Vandoideae, the anther is usually positioned on the tip of the column (figure 48) and looks like a little cap.

Figure 48 : Drawing of the typical anther position within the Vandoideae. (after Dressler 1981).



The anther appears to be erect which would indicate a primitive state of development (Dressler 1981). However, the Vandoideae are otherwise considered to be the most advanced subfamily of the Orchidaceae (Brieger 1973, Dressler 1981).
Within the "Variegata" the anther is invariable with the exception of Braasiella arizajuliana. In this monospecific genus, the anther cap shows a beaklike development (Figure 46).

4. 4. 2. 2. 5. 4. POLLINIA AND POLLINARIA

All orchids have their pollen grains stuck together in one way or another and this aggregation is adaptive in relation to the large numbers of ovules to be fertilized in the orchid ovary. Pollen grains can appear as monads, especially in some primitive orchids such as the Apostasioideae, Cypripedioideae and in the subtribe Vanillinae of the Epidendroideae. Usually however, they remain in tetrads or clump into larger masses. The structure of pollen grains has recently been used as a taxonomic marker in the Orchidaceae (Williams & Broome 1976, Schill & Pfeiffer 1977, Schill 1978, Newton & Williams 1978) but this seems to be useful only at the level of sub-families and tribes.

To a considerable extent, the pollinia are formed by the shape of the anther, and the number and shape of the pollinia reflect the form and the number of partitions of the anther. There may be two, four, six or eight partitions and accordingly we find orchids with two, four, six or eight pollinia. The higher numbers are considered indicators of a more primitive state.

The pollinia in the Orchidaceae can be club-shaped, spheroid, laterally flattened; their shape differs greatly.
The pollinia of the Oncidiinae are relative compact and have an extension. This extension is referred to as caudicle and serves as a stalk as well as a weak point, assuring that the pollinia break away when pushed against the stigmatic surface by the pollinating insect.

The pollinia, together with a strap of tissue called the stipe and a small sticky plate called the viscidium form a structure usually referred to as the pollinarium. This structure differs greatly within the Orchidaceae due to differences in the pollinia, viscidium and/or stipe (Figure 49). Because this structure differs, but remains more or less constant within lower taxa, it is a good taxonomic marker.

Within the Oncidiinae their are a number of different forms of pollinaria (figure 50). In order to be able to classify the form of pollinia of the "Variegata" in comparison to the other Oncidiinae, I have examined pollinaria of other genera, as well as all genera belonging to the "Variegata".

The pollinaria were removed from the plants, air dried in a petri dish at room temperature for at least 96 hours, mounted on an electron microscope stub and spatted with gold. They were than examined using a Scanning Electron Microscope JEOL JSM-S1. The electronmicrographs were taken with a 45 x 60 mm camera.

Figures 51 to 74 show the different pollinaria within the Oncidiinae .

Figure 49 : Different forms of pollinaria within the Orchidaceae (Combined from Dressler 1981)

Spiranthoideae : (A) Macodes sanderiana. (B) Prescottia stachyodes. (C) Ponthieva brenesii.
Orchidoideae : (D) Towmsonia viridis. (E) Eriochilus cucullatus.
Epidendroideae : (F) Calanthe brevicornu. (G) Meiracyllium wendlandii. (H) Appendicula cornuta. (I) Masdevallia zahlbruckneri.
Vandoideae : (J) Eulophia petersii. (K) Grammatophyllum scriptum. (L) Catasetum trulla. (M) Fernandezia sanguinea. (N) Houlletia lowiana. (O) Miltonia regnellii.

Scale 1mm.

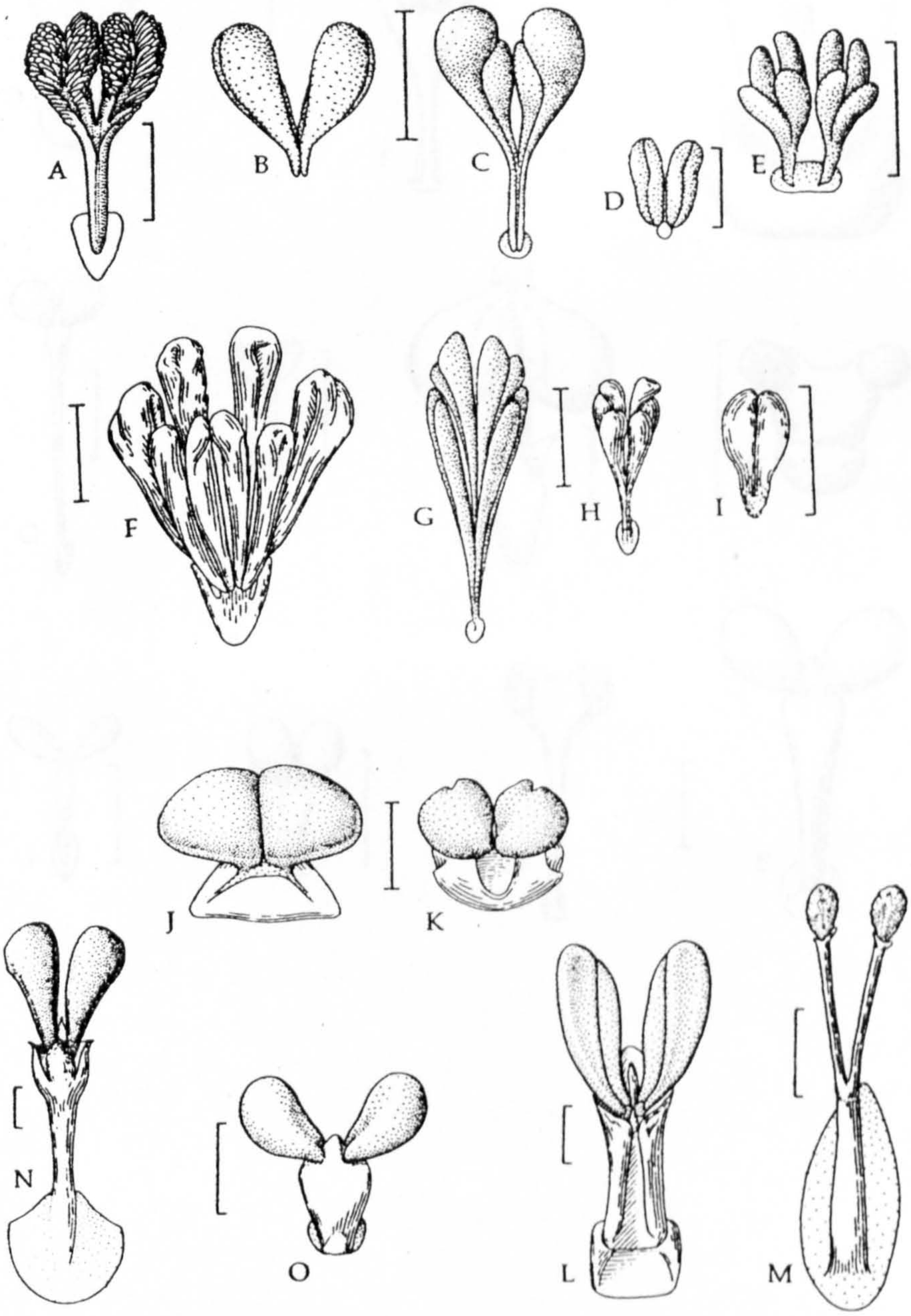


Figure 50 : Some forms of pollinaria within the Oncidiinae (after Dressler 1981)

(A) Oncidium cavendishianum. (B) Brassia arcuigera.
(C) Systeloglossum costaricense. (D) Odontoglossum maculatum.
(E) Comparettia macroplectron. (F) Trichopilia turialbae.
(G) Oncidium cheirophorum. (H) Oncidium ansiferum.
(I) Notylia bicolor. (J) Sigmatostalix guatemalense.
(K) Hybochilus inconspicuous.
Scale 1 mm.

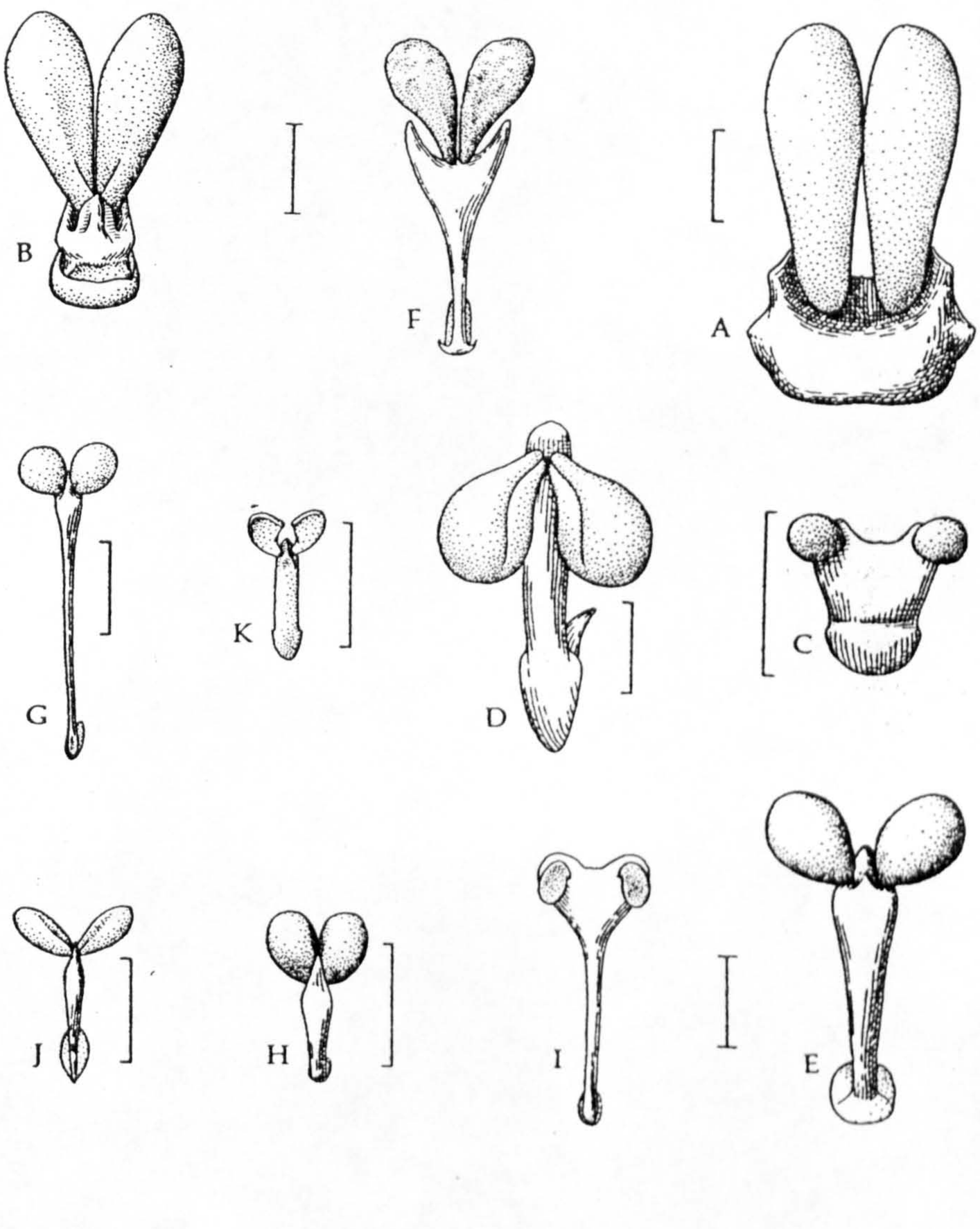


Figure 51 :
Hispaniella henekenii
(x47.5)

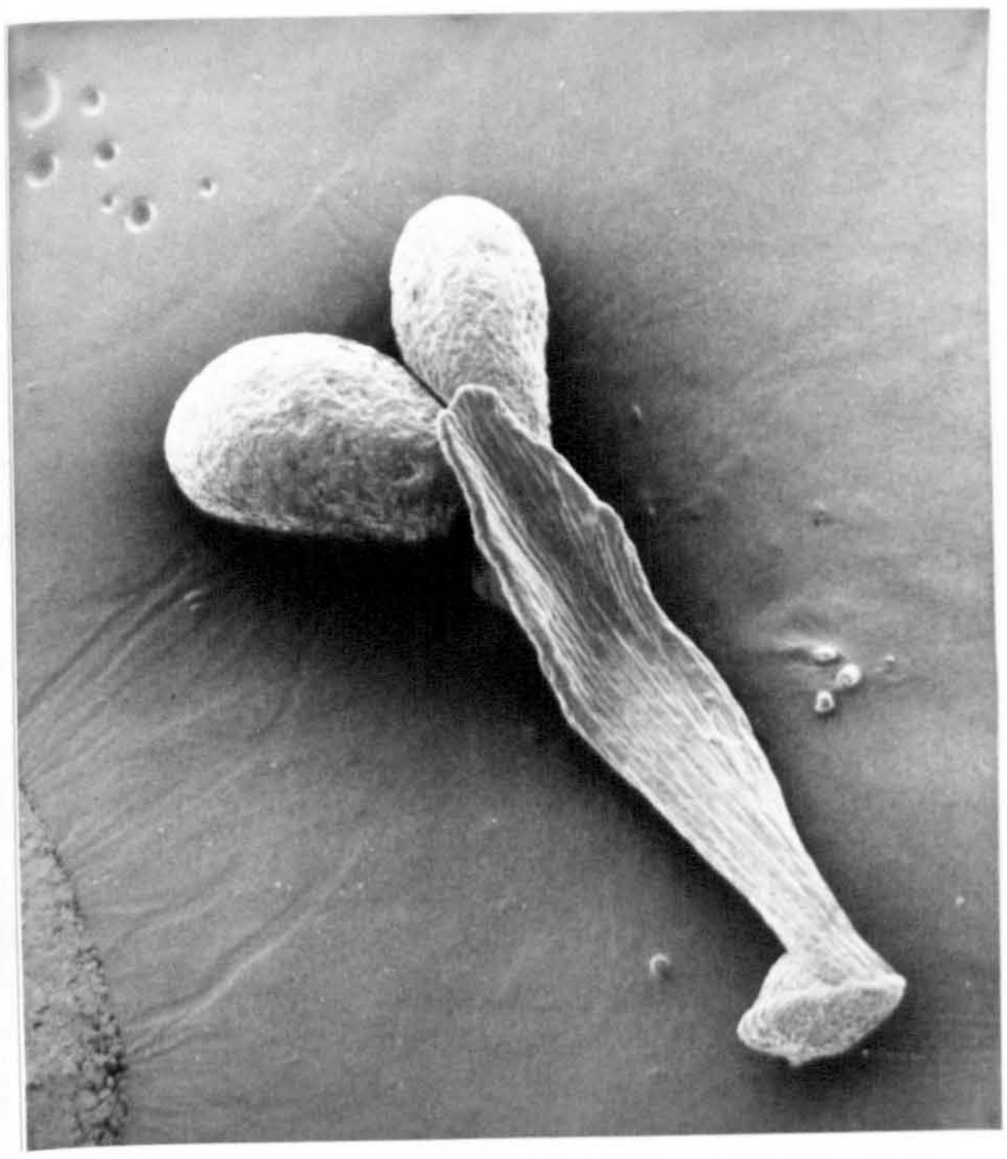


Figure 52 :
Olgasis triquetra
(x47.5)

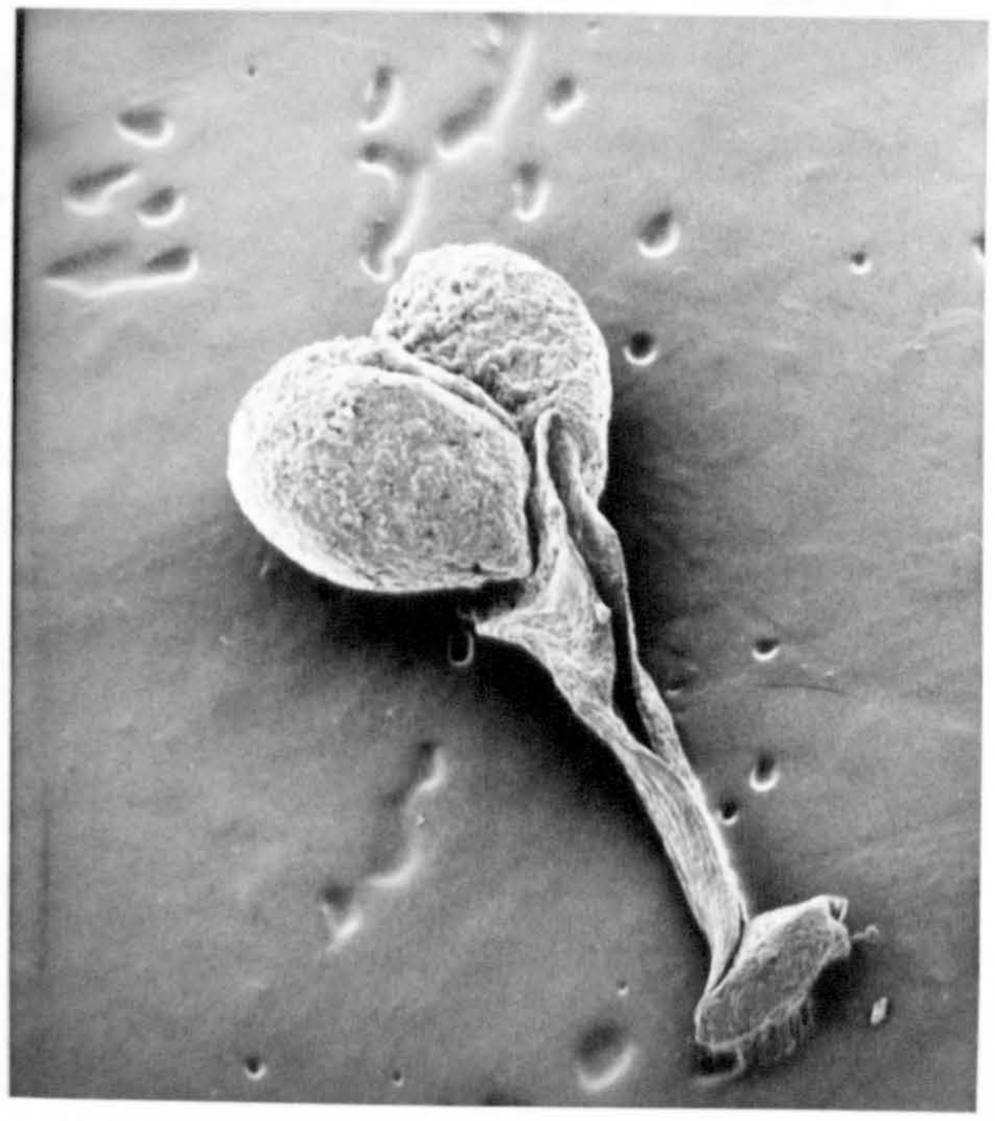


Figure 53 :
Tolumnia bahamensis
(x47.5)

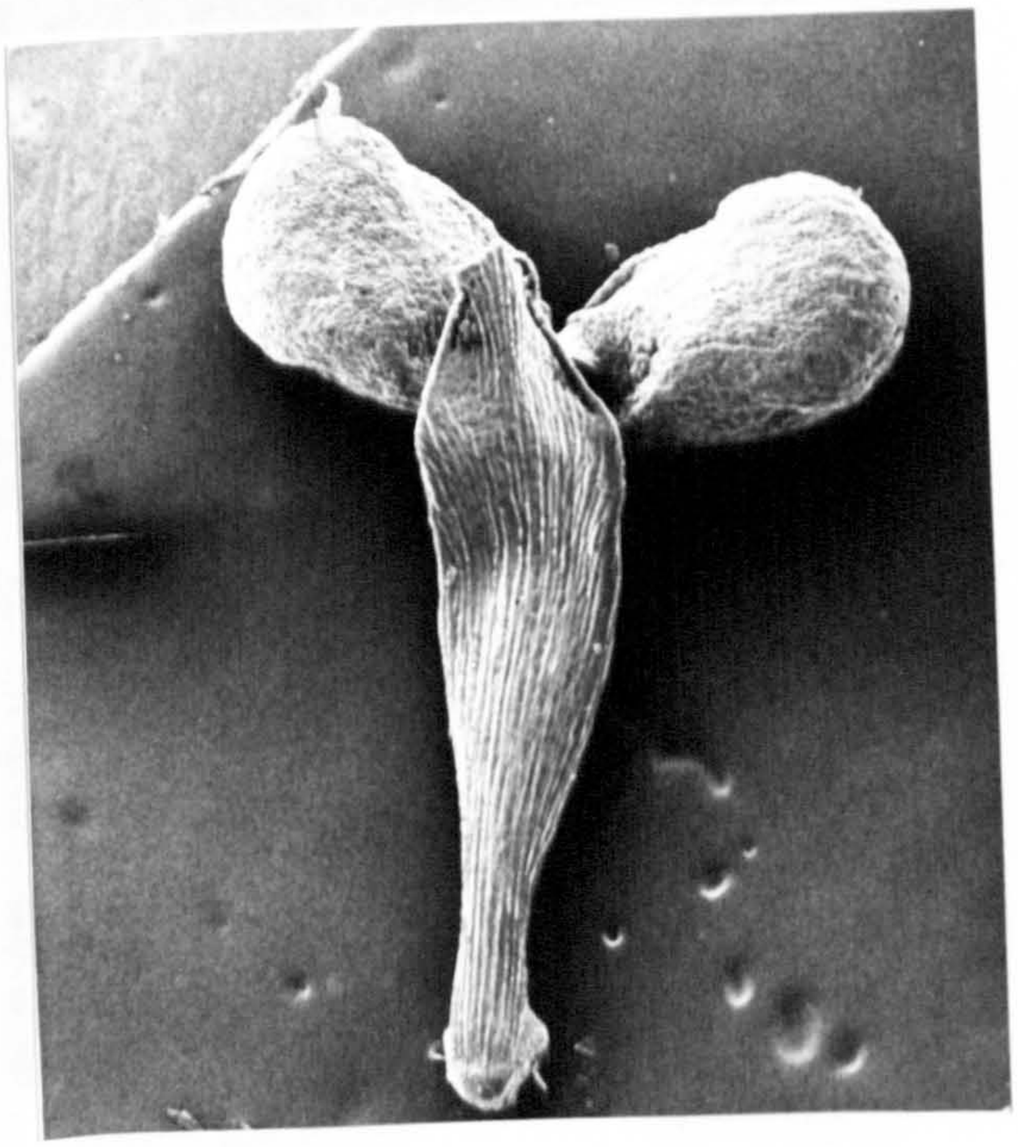


Figure 54 :
Tolumnia pulchella
(x65)

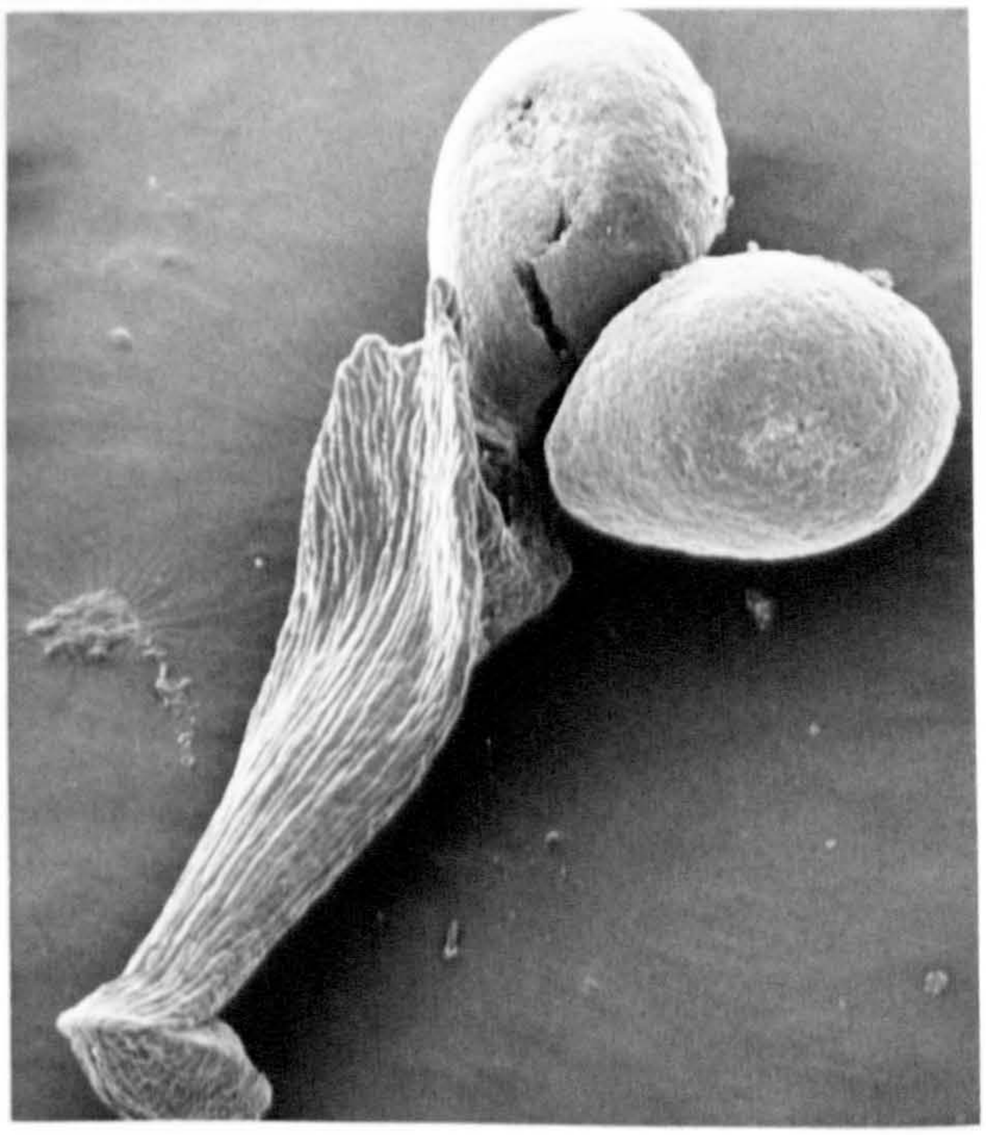


Figure 55 :
Tolumnia sasseri
(x82.5)

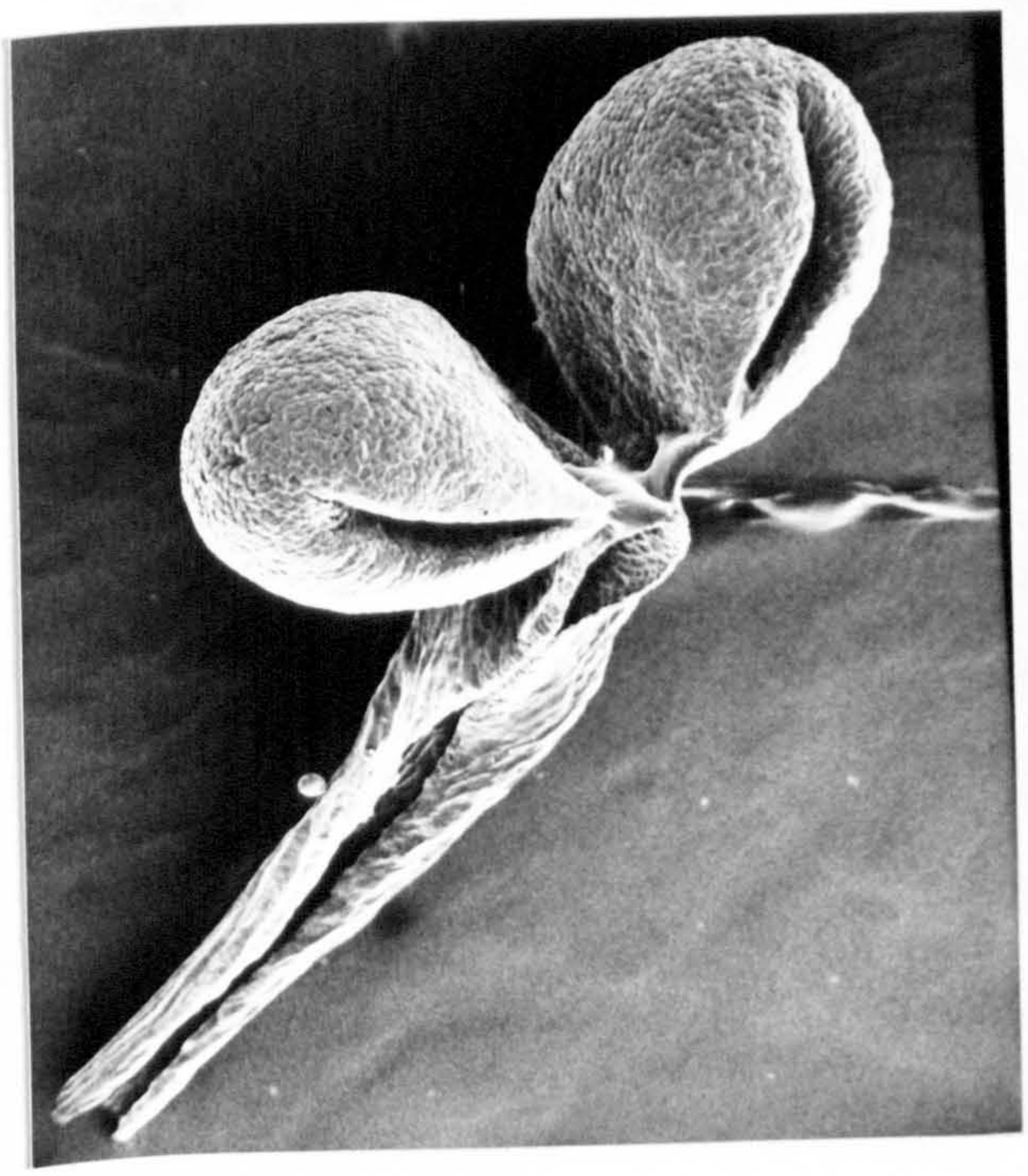


Figure 56 :
Tolumnia tetrapetala
(x82.5)

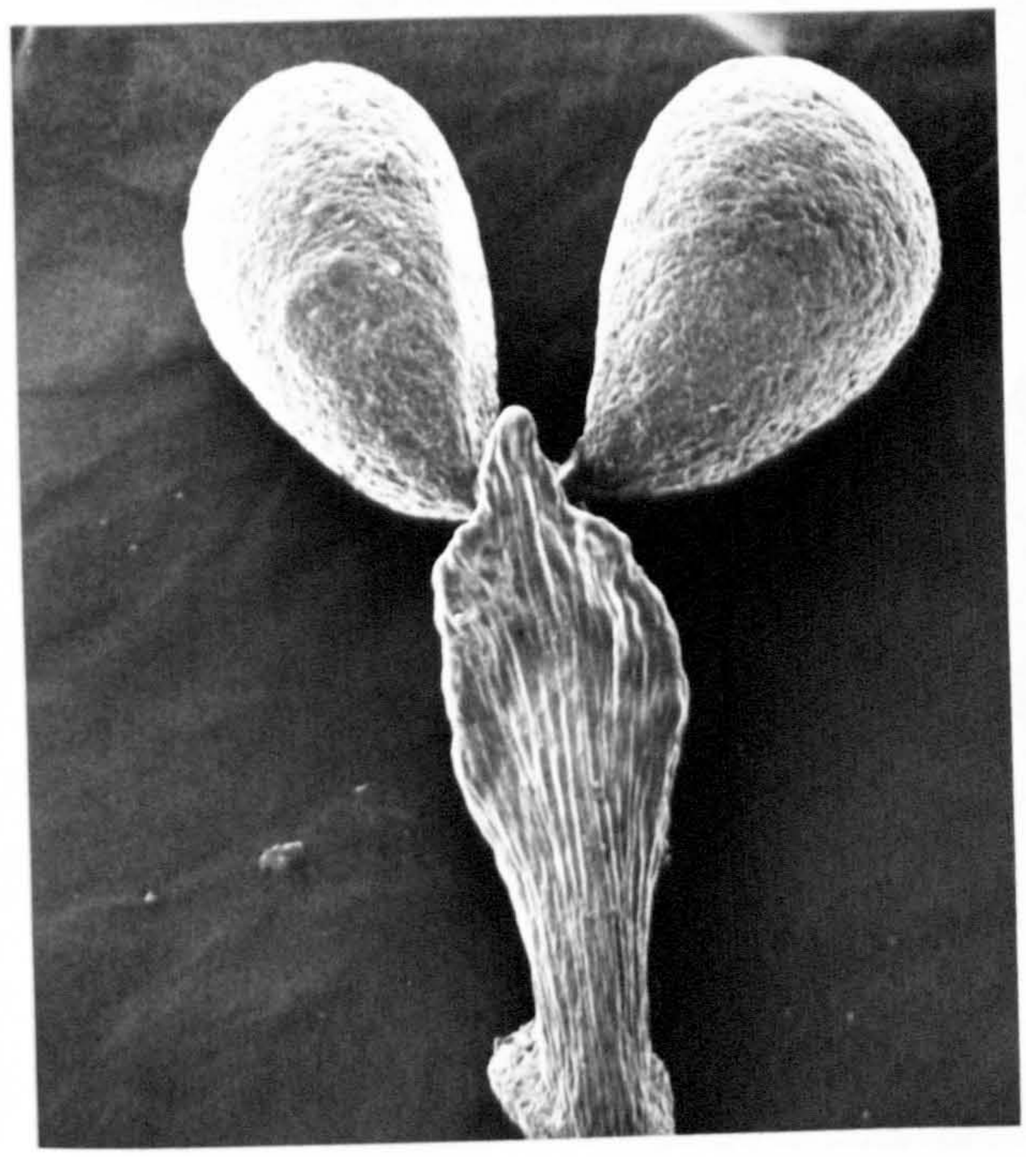


Figure 57 :
Tolumnia urophylla
(x65)

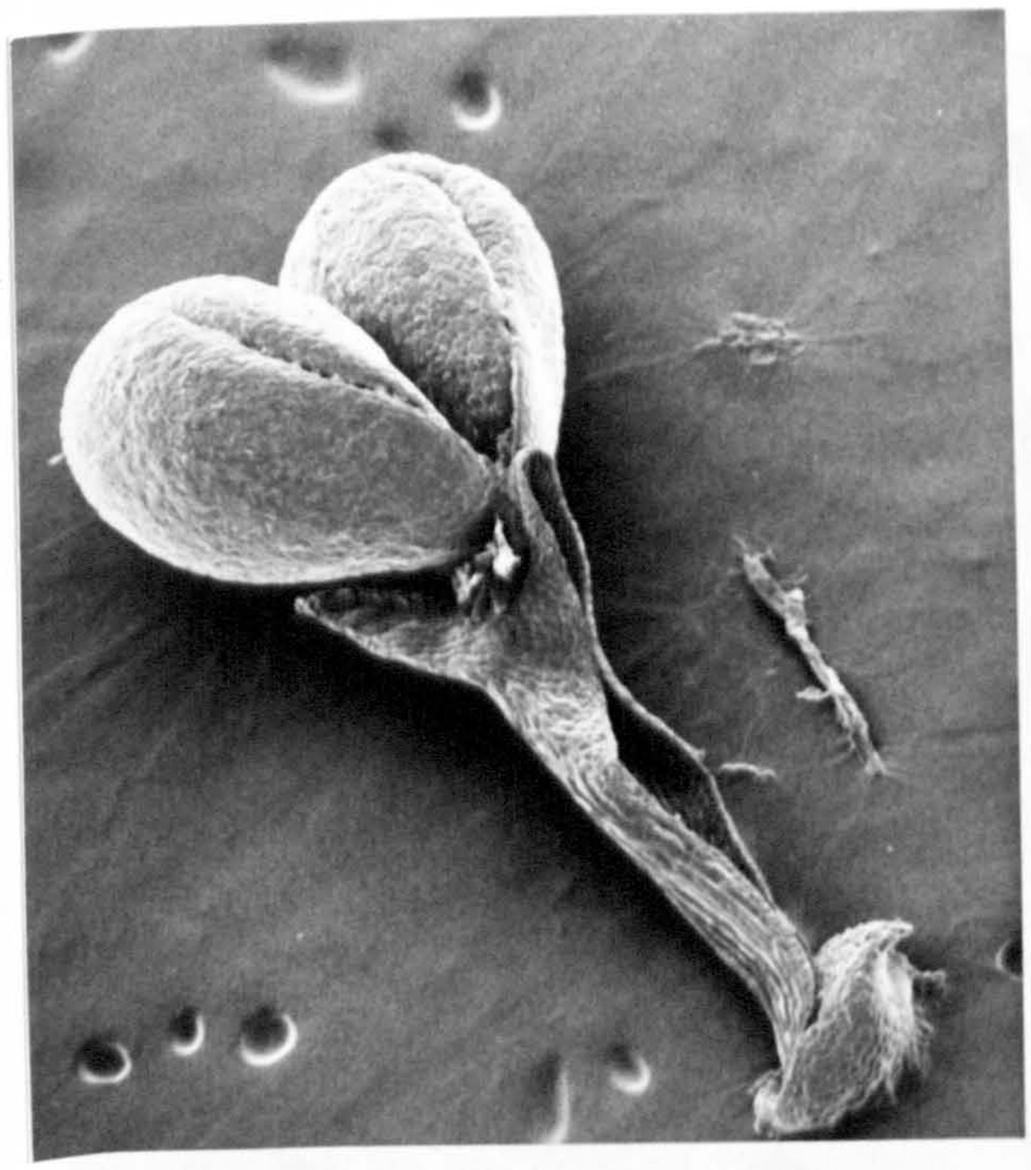


Figure 58 :
Tolumnia variegata
(x65)

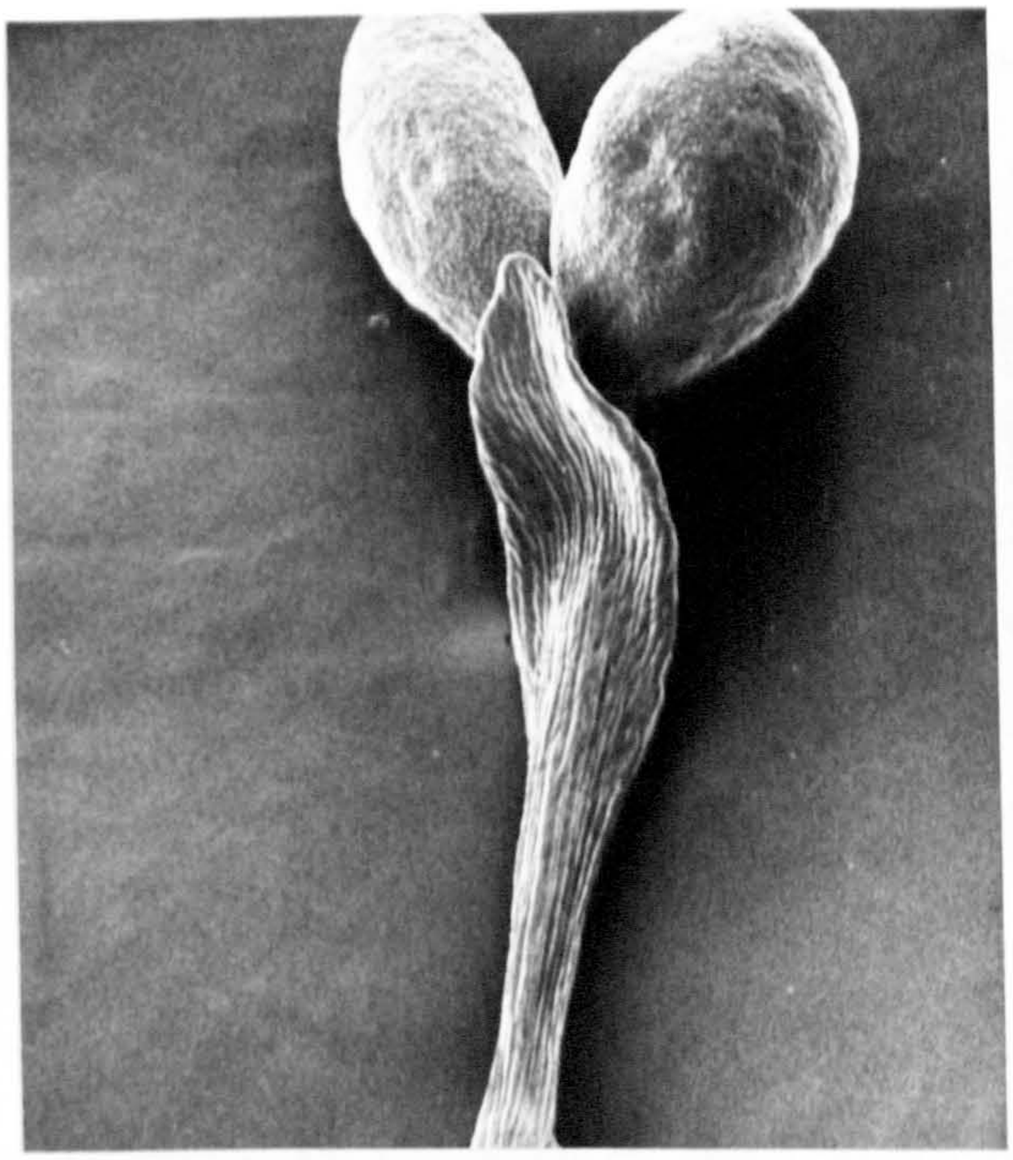


Figure 59 :
Psychopsis krameriana
(x32.5)

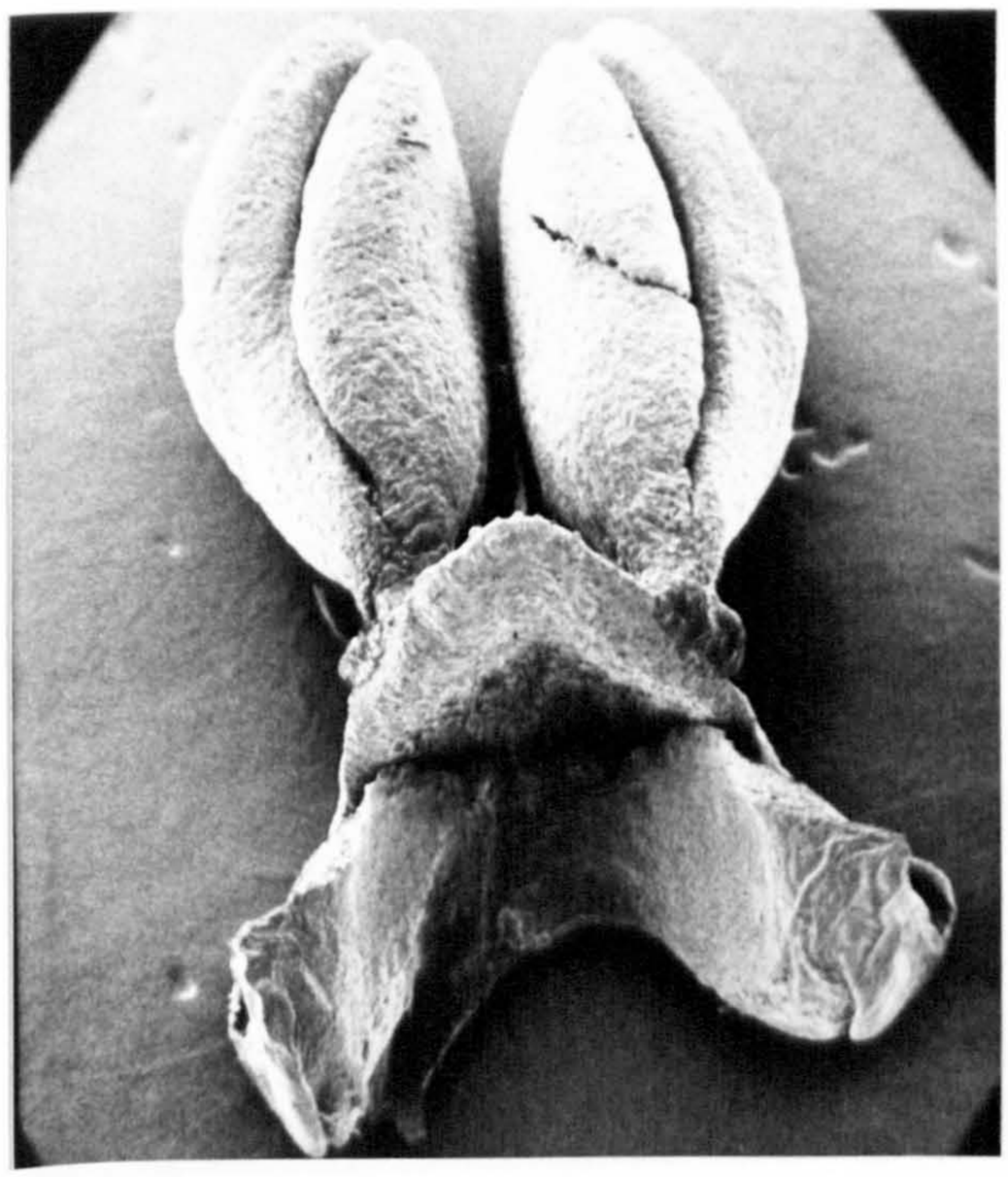


Figure 60 :
Oncidium sp.
(Sect. Cyrtochilum) (x47.5)

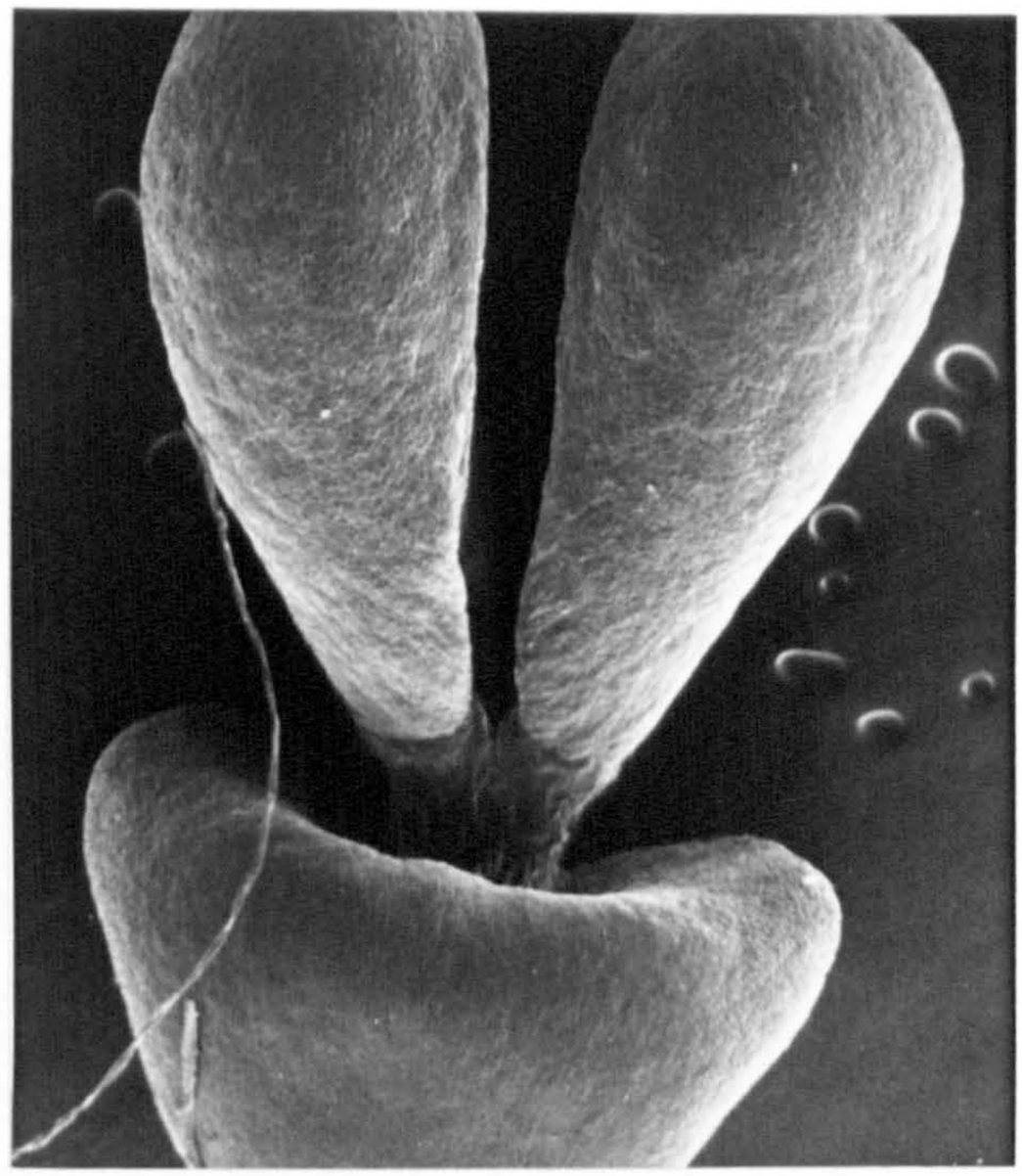


Figure 61 :
Oncidium luridum
(Sect. Plurituberculata) (x30)

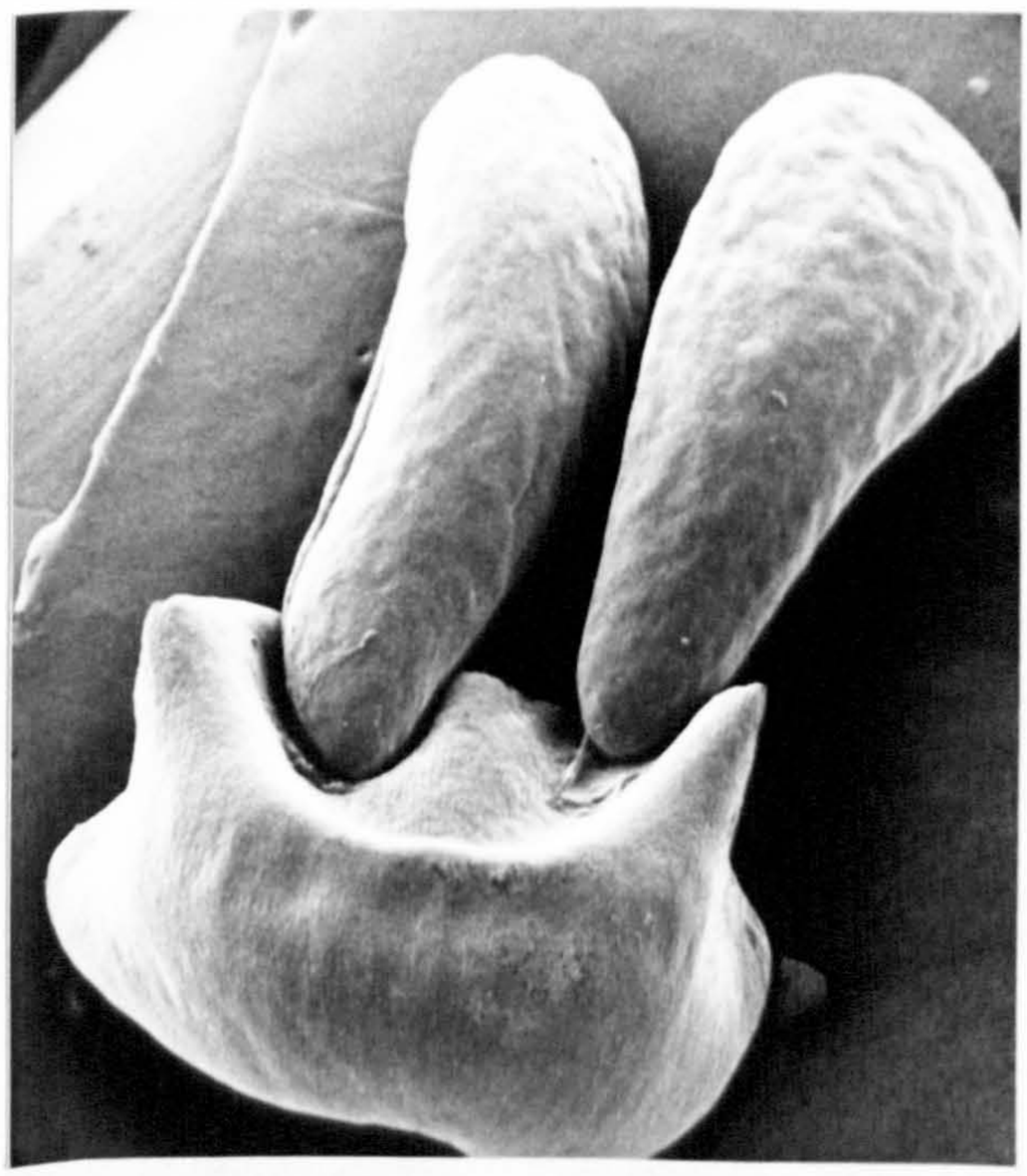


Figure 62 :
Oncidium cheirophorum
(Sect. Rostrata) (x30)

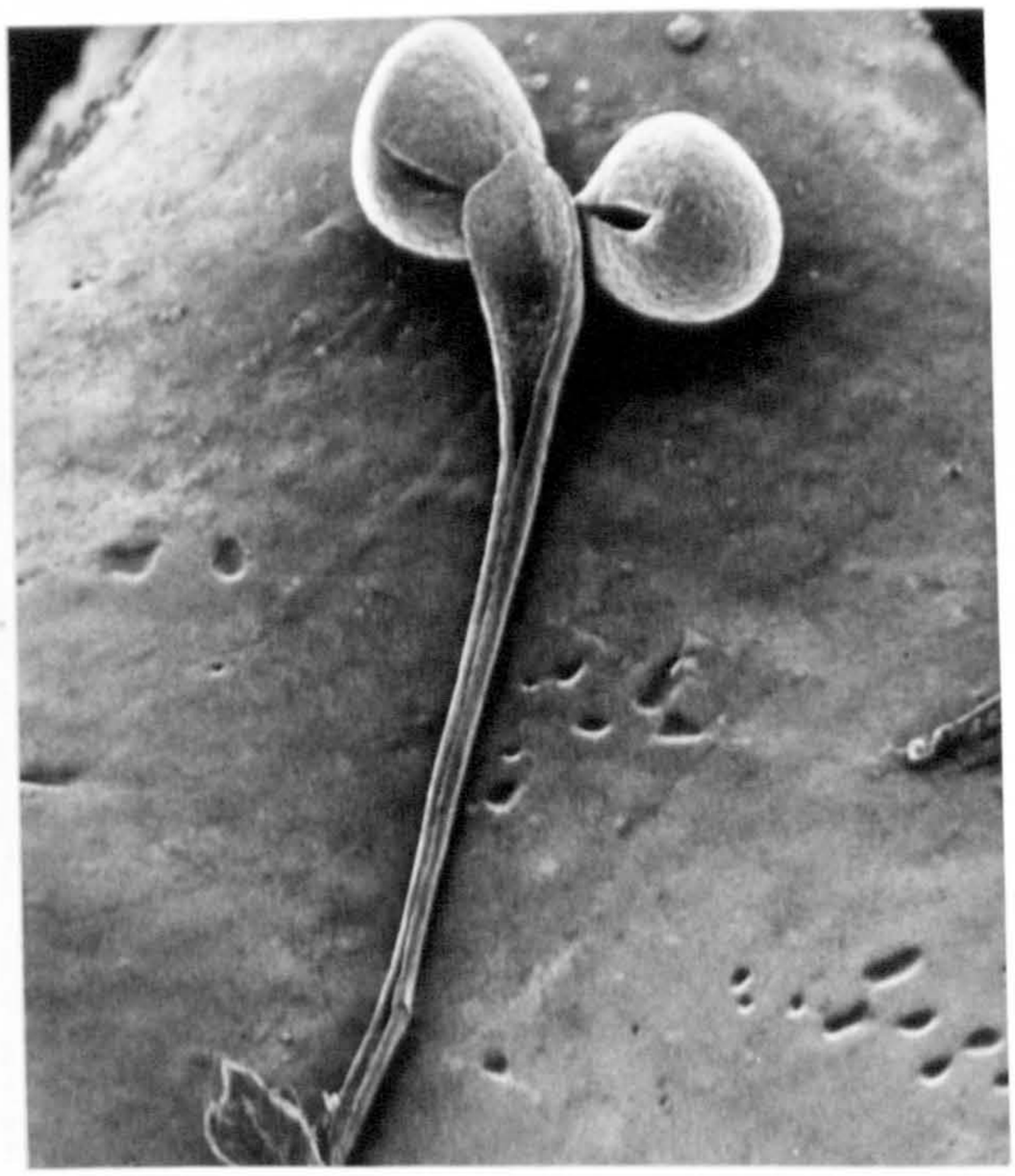


Figure 63 :
Oncidium gardneri
(Sect. Crispa) (x47.5)

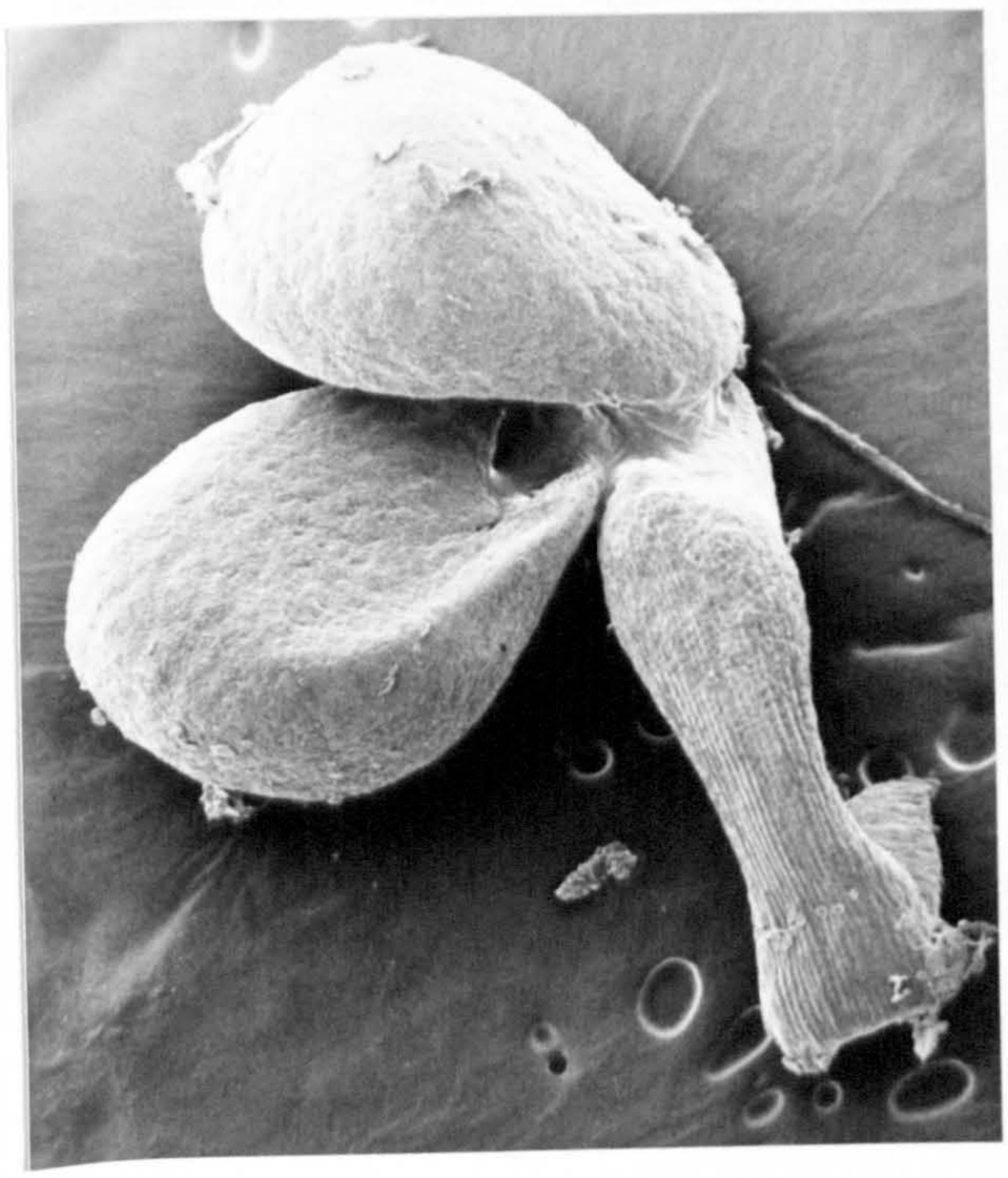


Figure 64 :
Oncidium reflexum
(Sect. Oblongata) (x47)

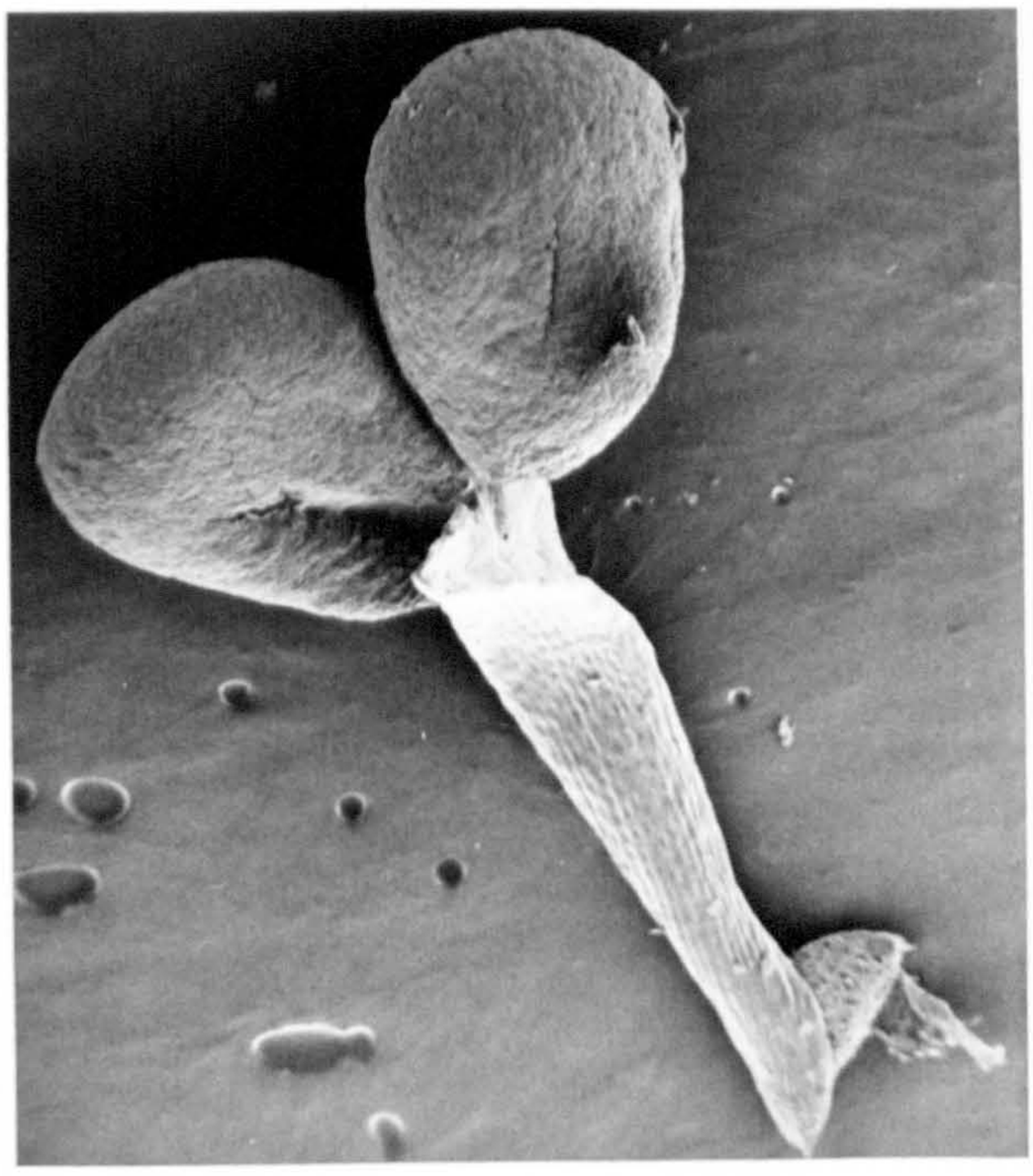


Figure 65 :
Oncidium phalaenopsis
(Sect. Cucullata) (x47.5)

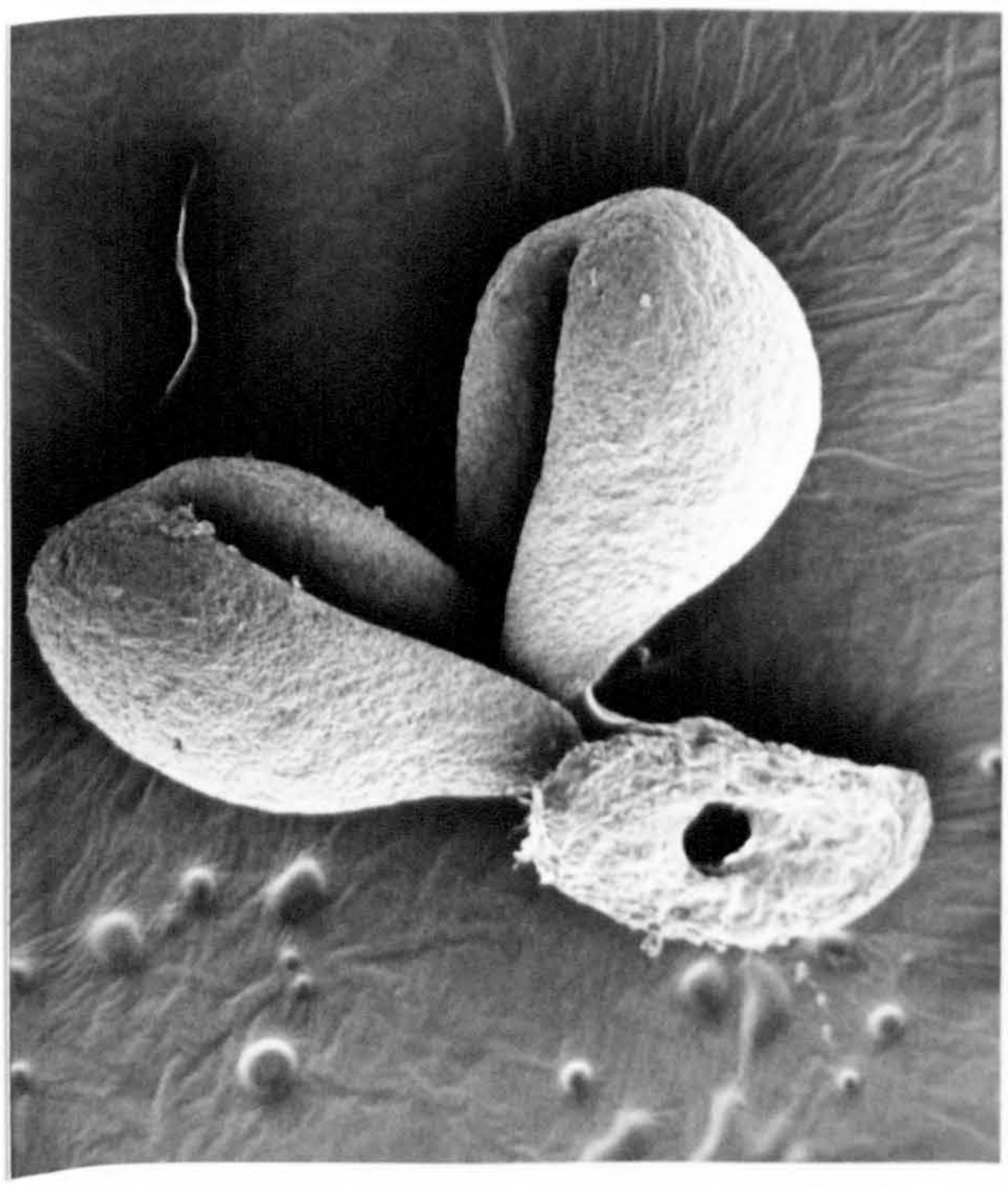


Figure 66 :
Oncidium longicornu
(Sect. Rhinocerotes) (x100)

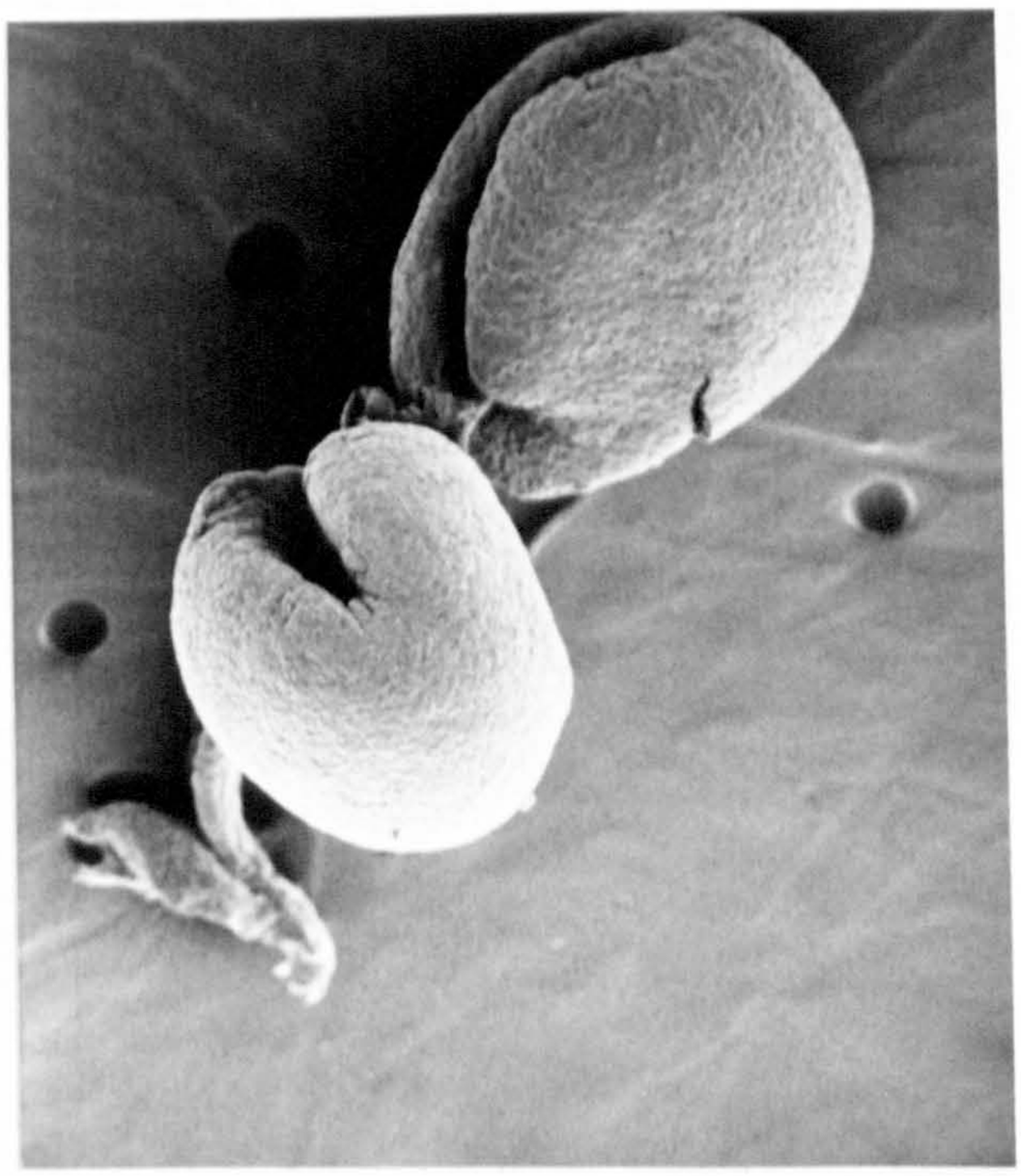


Figure 67 :
Oncidium gracile
(Sect. Concoloria) (x65)

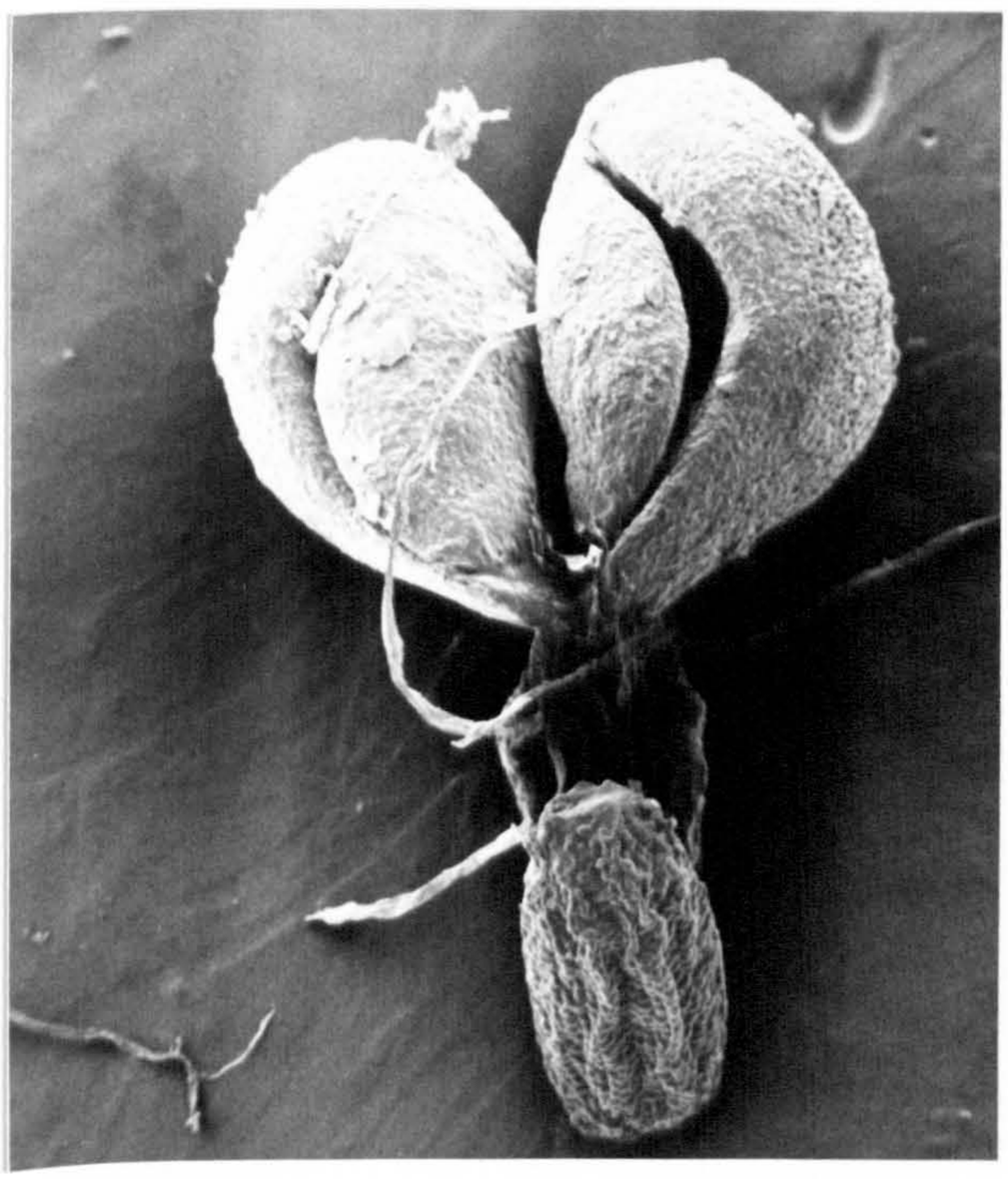


Figure 68 :
Oncidium pubes
(Sect. Waluewa) (x65)

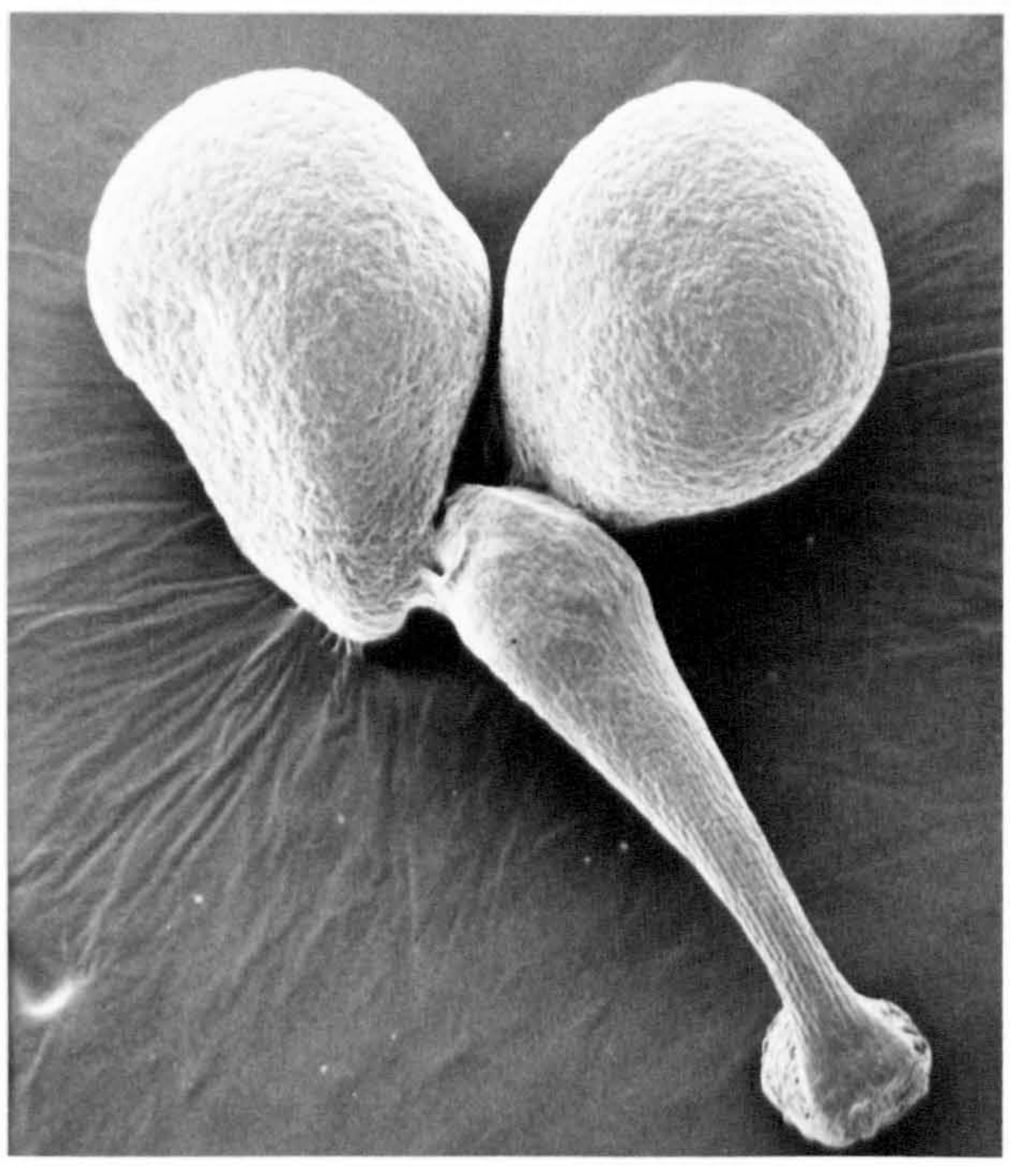


Figure 69 :
Oncidium sphacelatum
(Sect. Planifolia) (x47.5)

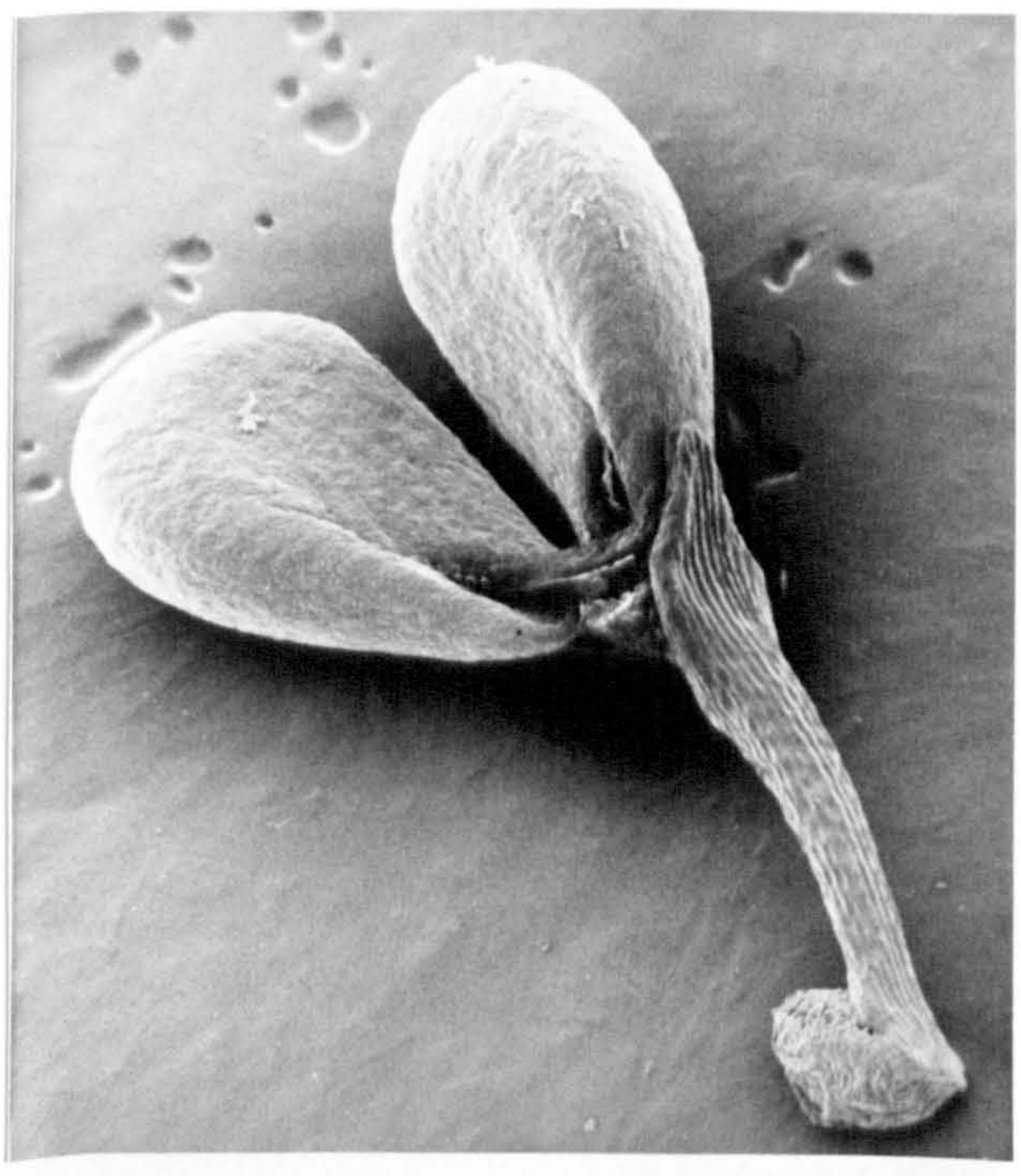


Figure 70 :
Odontoglossum laeve
(x30)

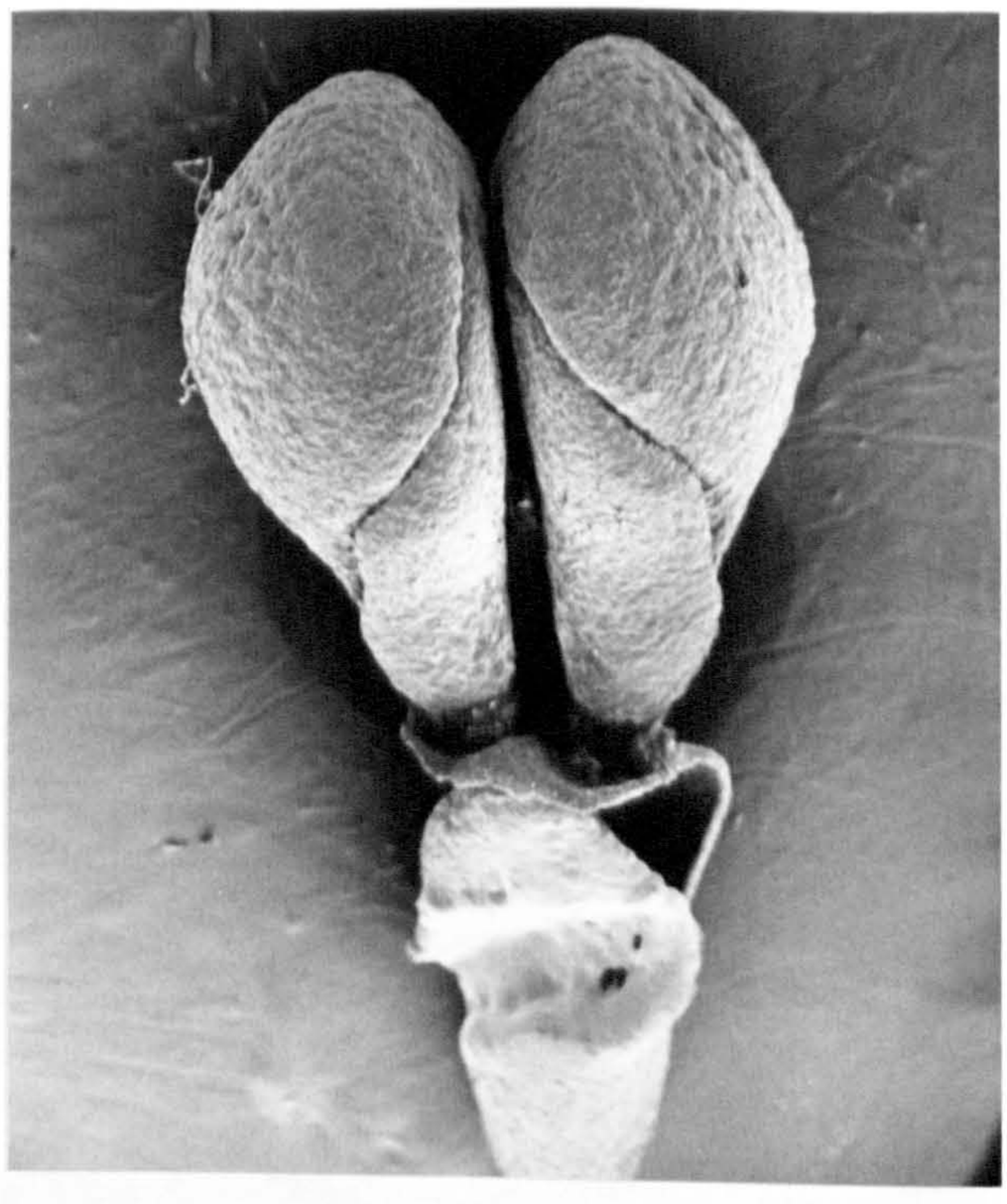


Figure 71 :
Brassia sp.
(x65)

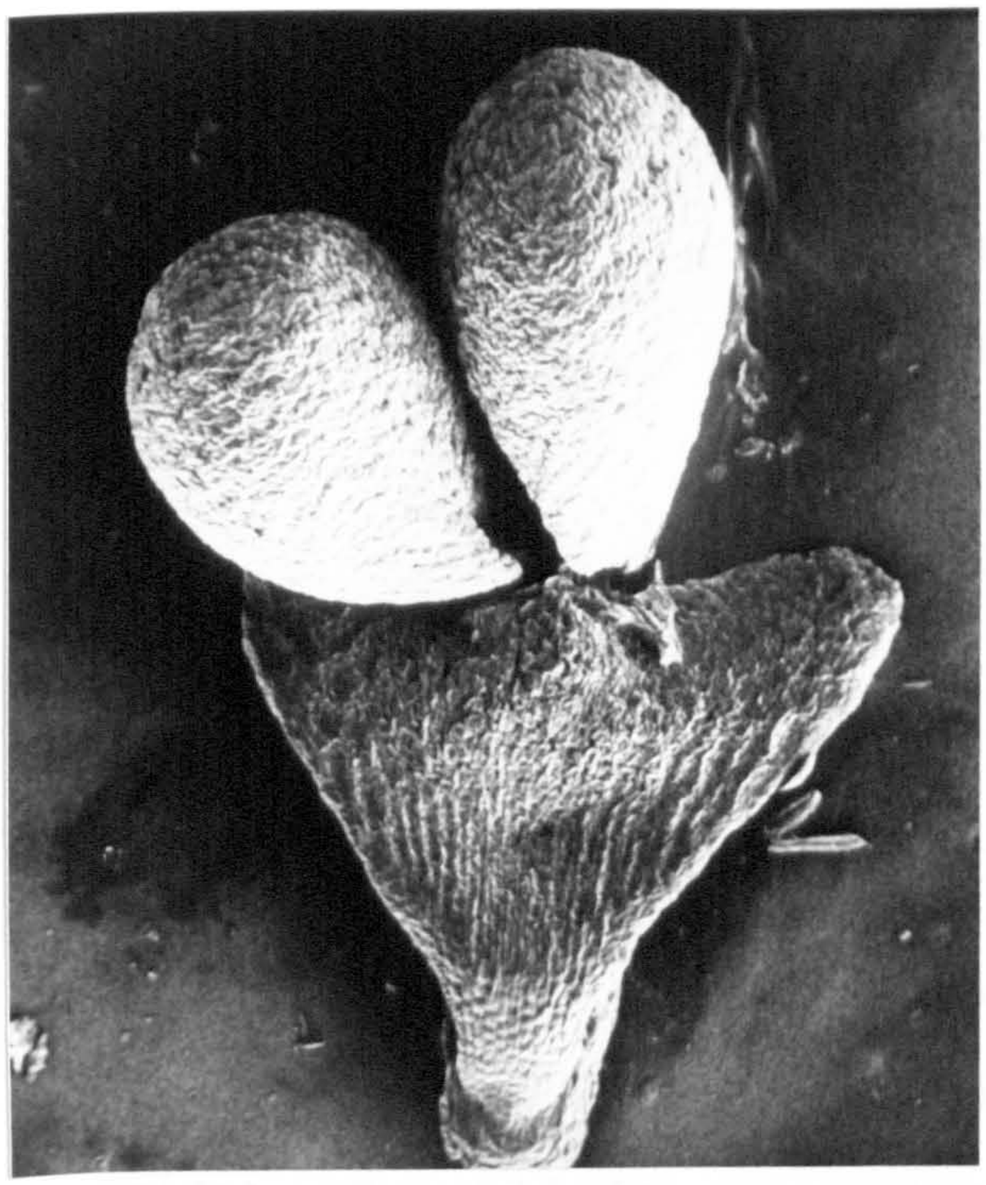


Figure 72 :
Cochlioda rosea
(x82)

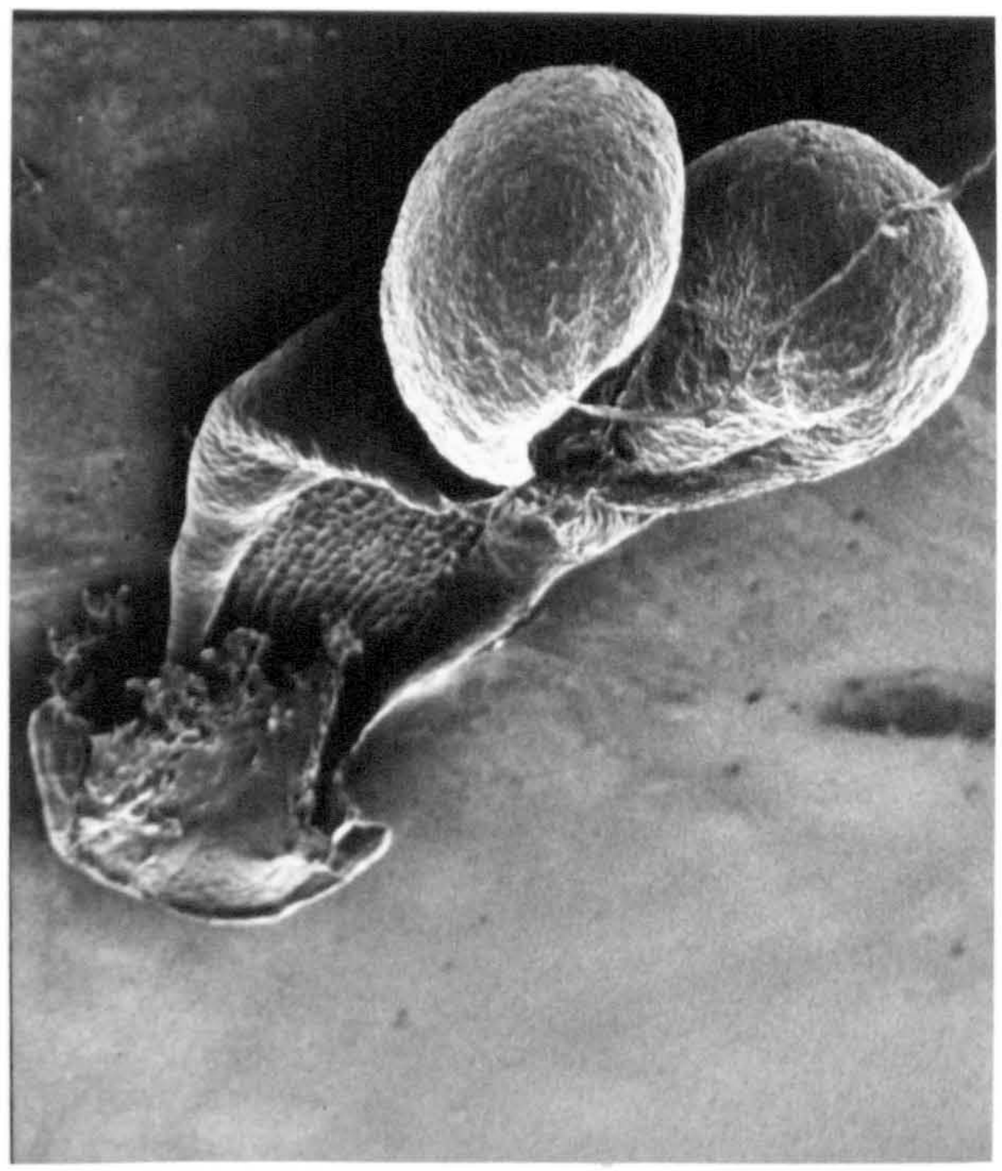


Figure 73 :
Comparettia macroplectron
(x20)

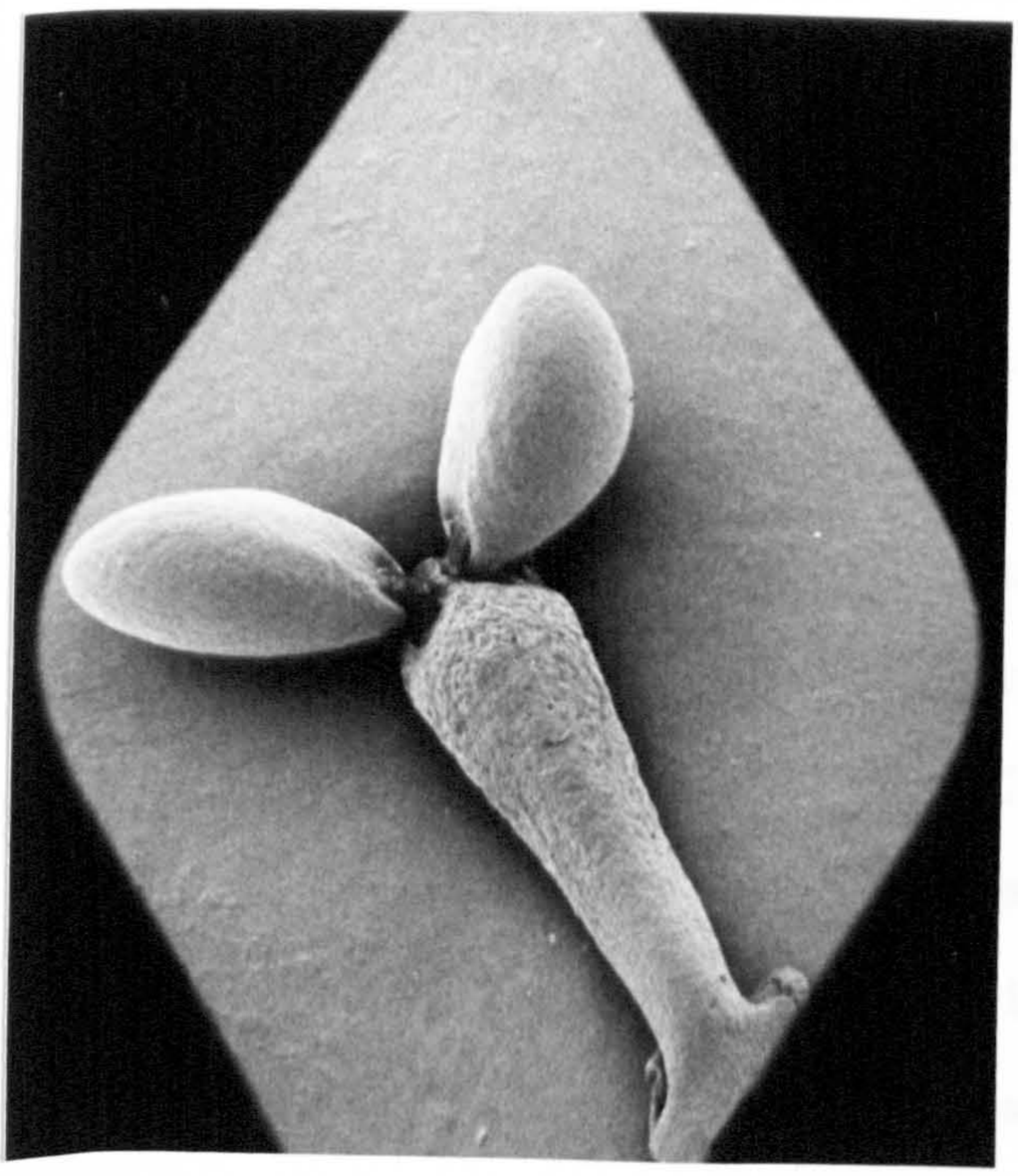
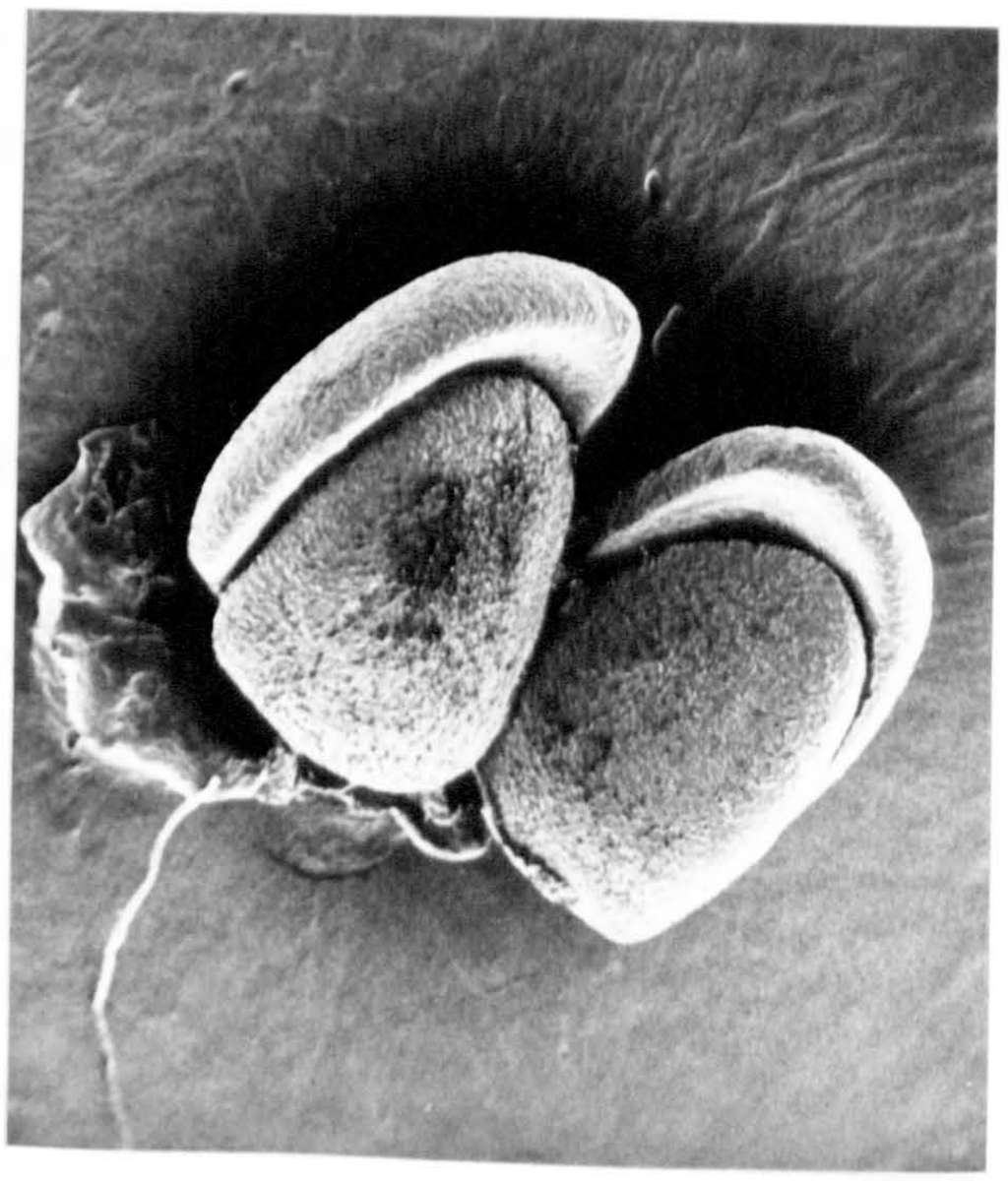


Figure 74 :
Maxillaria pophyrostele
(x38)



The results show that the pollinaria morphology differs considerably within the subtribe Oncidiinae. Among the genera belonging to the "Variegata" we find two different pollinaria structures whereby all species with the exception of Braasiella arizajuliana show the same structure. The pollinaria of Braasiella arizajuliana differs in shape and size (see figure 46)

	Braasiella	other "Variegata"
Length of stipe	7.6 mm	1.2 - 1.5 mm
Width of stipe	0.16 mm	0.35 mm
Form of pollinia	spheroid	ovoid
Height of pollinia	0.5 mm	0.6 - 0.7 mm
Width of pollinia	0.5 mm	0.45 mm

(For the purpose of all further study, the form corresponding to Braasiella arizajuliana will be referred to as type A whereas the form of pollinaria corresponding to the other species of the "Variegata" will be referred to as type B).

This difference was one of the reasons for separating Braasiella arizajuliana from Oncidium (Braem, Lückel & Rüssmann 1984).

The structure of the pollinaria of Braasiella arizajuliana is similar to that of Oncidium cheirophorum, one of the species included in the section Rostrata of the genus Oncidium (fig. 62). The pollinaria structure of all other species of the "Variegata" suggest some relationship to some sections of the genus Oncidium sensu Garay and to the genus Comparettia. The differences of the pollinaria of the "Variegata" to all other groups within the Oncidiinae are considerable.

Up to date, the few attempts to revise groups of orchids within the Oncidiinae (Kränzlin 1922, Garay 1970, Garay & Stacy 1974, Bockemühl 1983-1986, Brieger & Lückel 1983-1984) have not considered differences in the morphology of the pollinaria as a taxonomic marker and some of these studies may have to be amended when the differences in pollinaria structure on tribal and subtribal level are examined extensively. Indeed, the structure of the pollinaria should be highly weighted as a taxonomic marker. It is apparently of major phylogenetic significance because it is highly correlated with many other characters (structure of the anther, presence of stipe and/or viscidium, correlation with pollination agent). Such studies will probably indicate that "macrogenera" like Oncidium s.l., Odontoglossum, and Maxillaria, are anthropogenic agglomerates instead of natural phylogenetic groups, if the major phylogenetic weighting of pollinarium structure is considered valuable, for each shows more than one major type of pollinarium.

4. 4. 2. 2. 6. SEED CAPSULE

During my studies in the field, I noticed that one of the species of the genus Tolumnia differs from all other species within the "Variegata" in the form and the surface morphology of the seed capsule.

Whereas a smooth, oblong cylindrical capsule is the rule within the group, Tolumnia quadrilobia develops a more spheroidal capsule with a spiny surface. This feature is so distinct and so specific, that it may be used to differentiate

Tolumnia quadrilobia from all other plants of the group. The feature is not dominant in Tolumnia x osmentii, the natural hybrid between Tolumnia quadrilobia and Tolumnia haitiensis which has the smooth oblong capsule of Tolumnia haitiensis.

4. 4. 2. 2. 7. SEED

Seed structure has been much neglected as a taxonomic marker in the Orchidaceae, although as early as 1863, the German botanist Beer did some introductory work on the subject. Clifford & Smith (1969) examined a number of orchid seeds under the light microscope, and Barthlott (1976) used the electron microscope for his study of the seed surface structure of a larger number of orchid species.

Although Barthlott concludes that seed structure is especially useful at the subtribal and tribal levels, his studies also show the importance of this feature at the generic level. Ziegler, a student of Barthlott, examined the seed surface structure of some species of Tolumnia using material originating from my first voyage to Jamaica. He recognized differences in the seed-surface structure of Olgasis triquetra, Tolumnia pulchella and Tolumnia tetrapetala from other genera within the Oncidiinae (Ziegler, 1981). He found that there were raised parts on the cell walls of the testa of the "Variegata".

I collected seed of all species of the "Variegata" which I could get to flower. I also collected seed from a number of

reference species of other genera within the subtribe to follow up these results.

The seeds were air dried at room temperature in a petri dish for at least 5 days. They were then mounted on a electron microscope stub and spatted with gold. They were examined in an Scanning Electron Microscope type JEOL JSM-S1. Photoelectronmicrographs were taken with a 45 x 60 mm camera.

All species belonging to the genera Braasiella, Hispaniella, Olgasis and Tolumnia with the exception of Tolumnia tuerckheimii (Cogniaux) Braem show the curious elevations on their cell borders as do species of the related genera Comparettia, Ionopsis and Rodriguezia. All species of all other genera of the Oncidiinae, including all species of the other sections of the genus Oncidium sensu Garay and Stacy, which were examined did not show such raised structures.

Figures 75 to 94 show typical specimens from plants of each group.

Figure 75 :
Braasiella arizajuliana
(x1000)

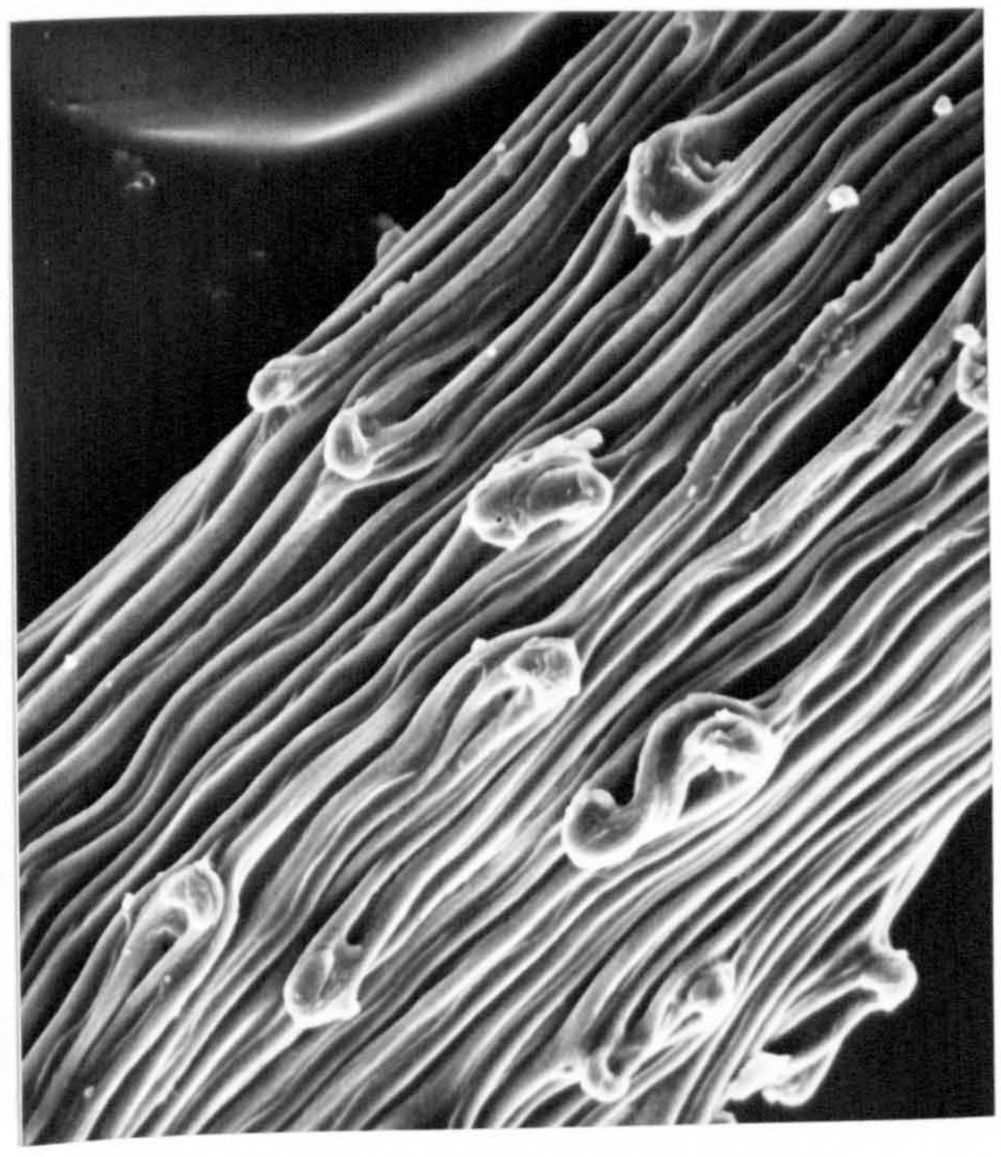


Figure 76 :
Hispaniella henekenii
(x1000)

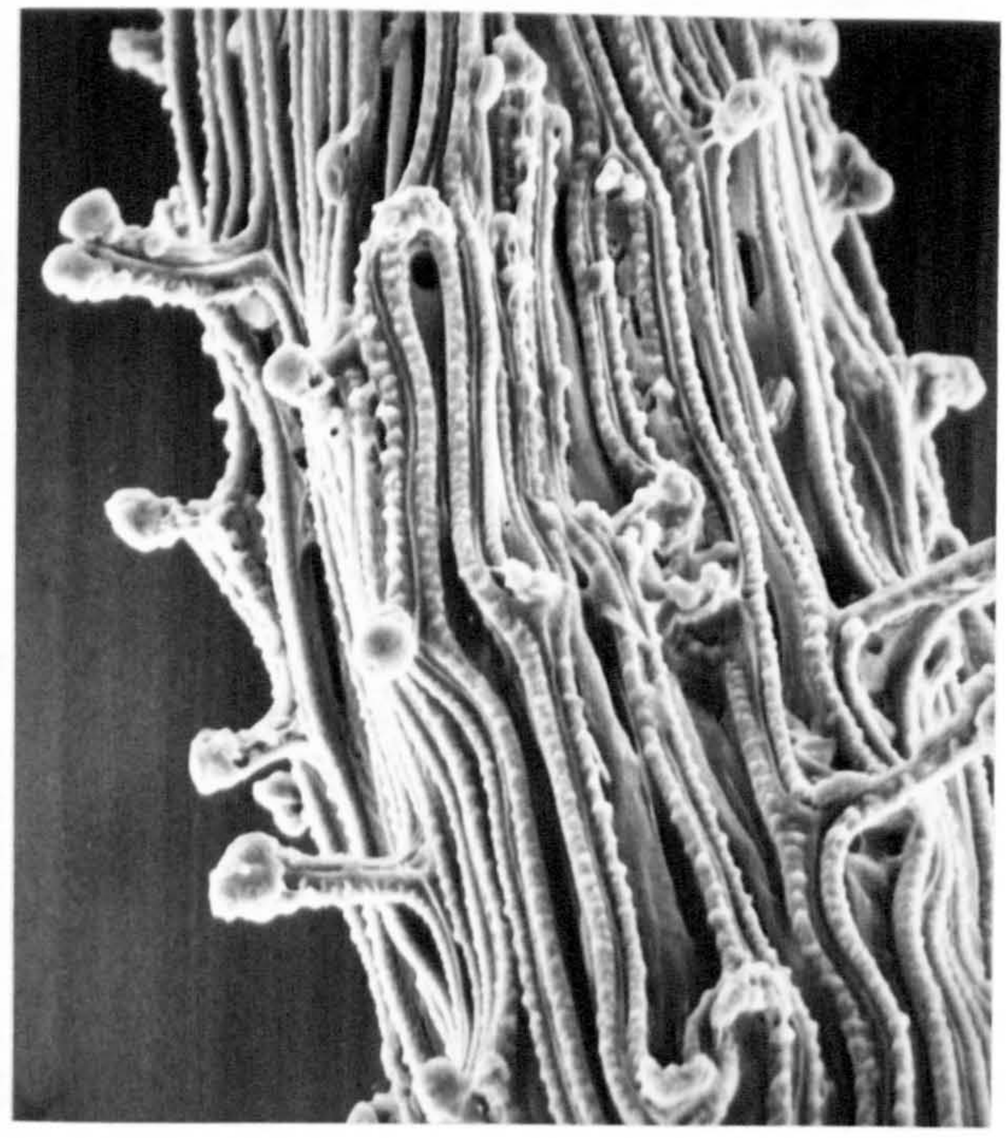


Figure 77 :
Tolumnia prionochila
(x1000)

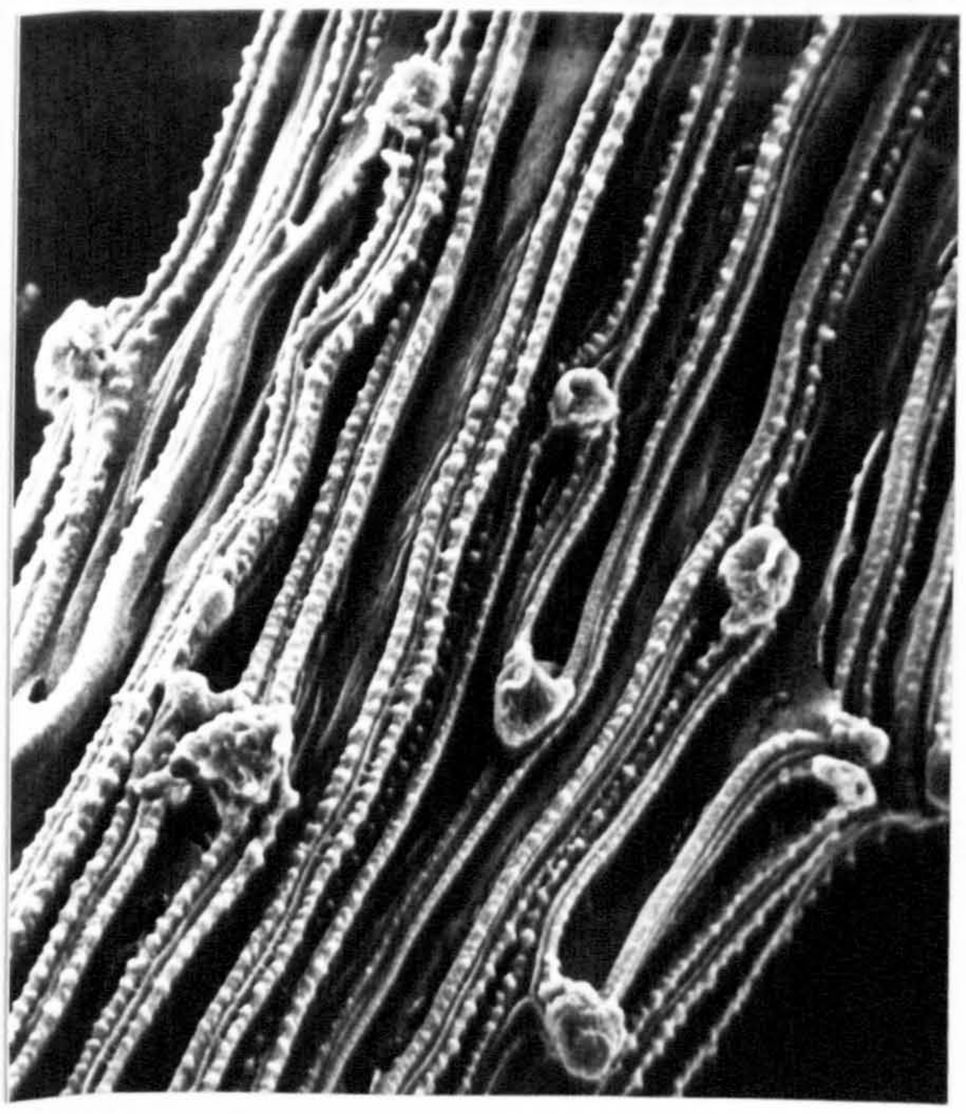


Figure 78 :
Tolumnia pulchella
(x1000)

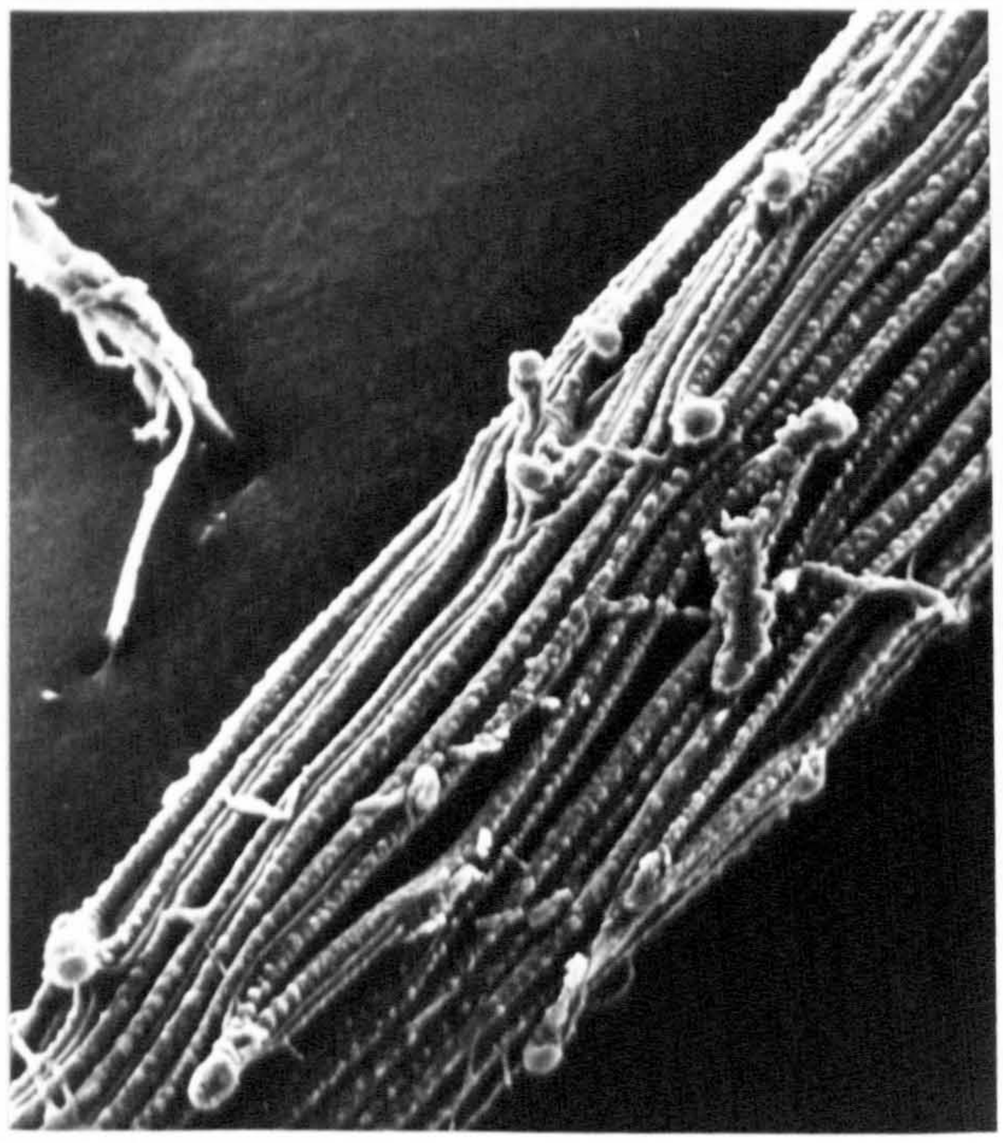


Figure 79 :
Tolumnia quadrilobia
(x1000)

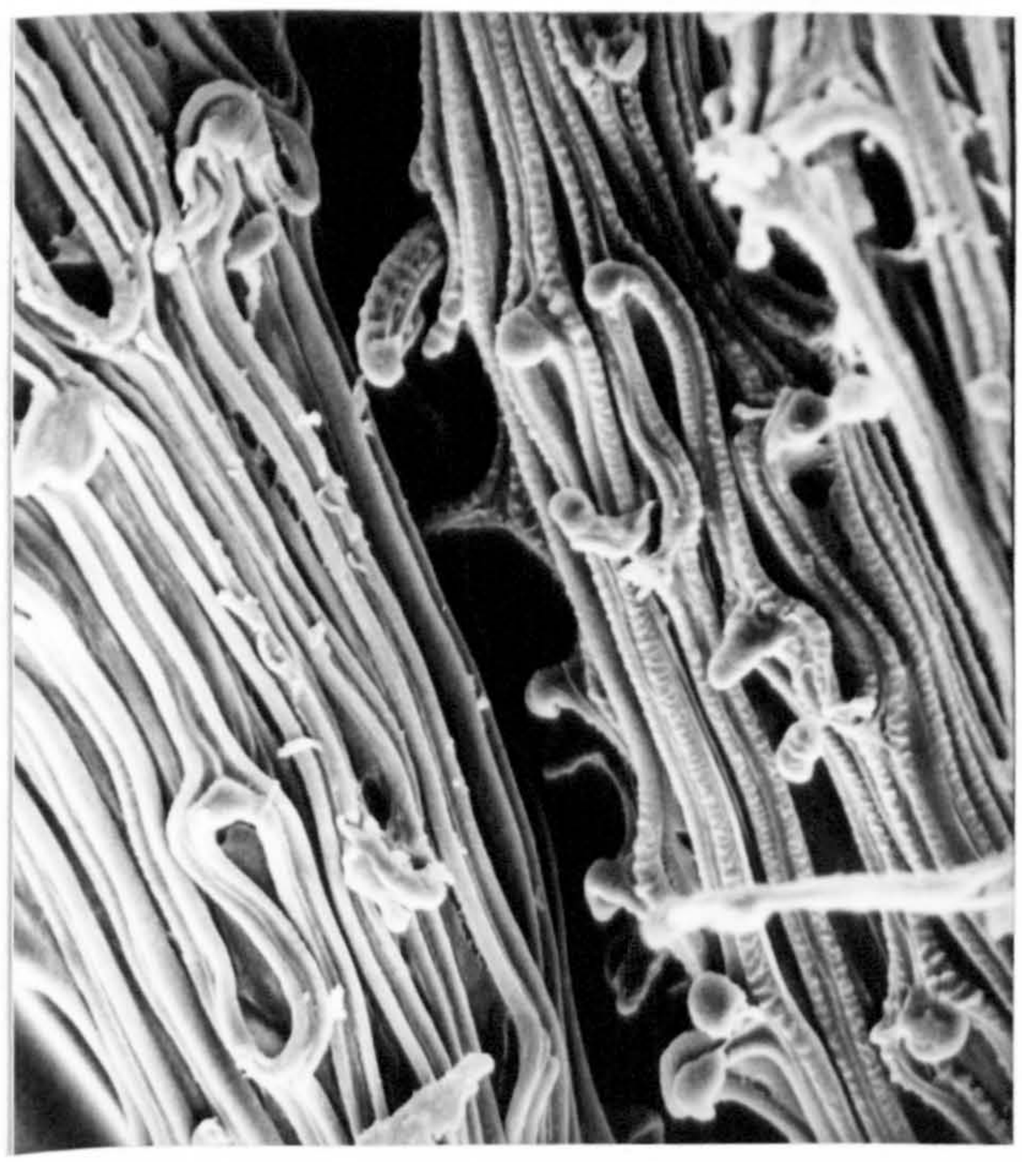


Figure 80 :
Tolumnia sylvestris
(x1000)

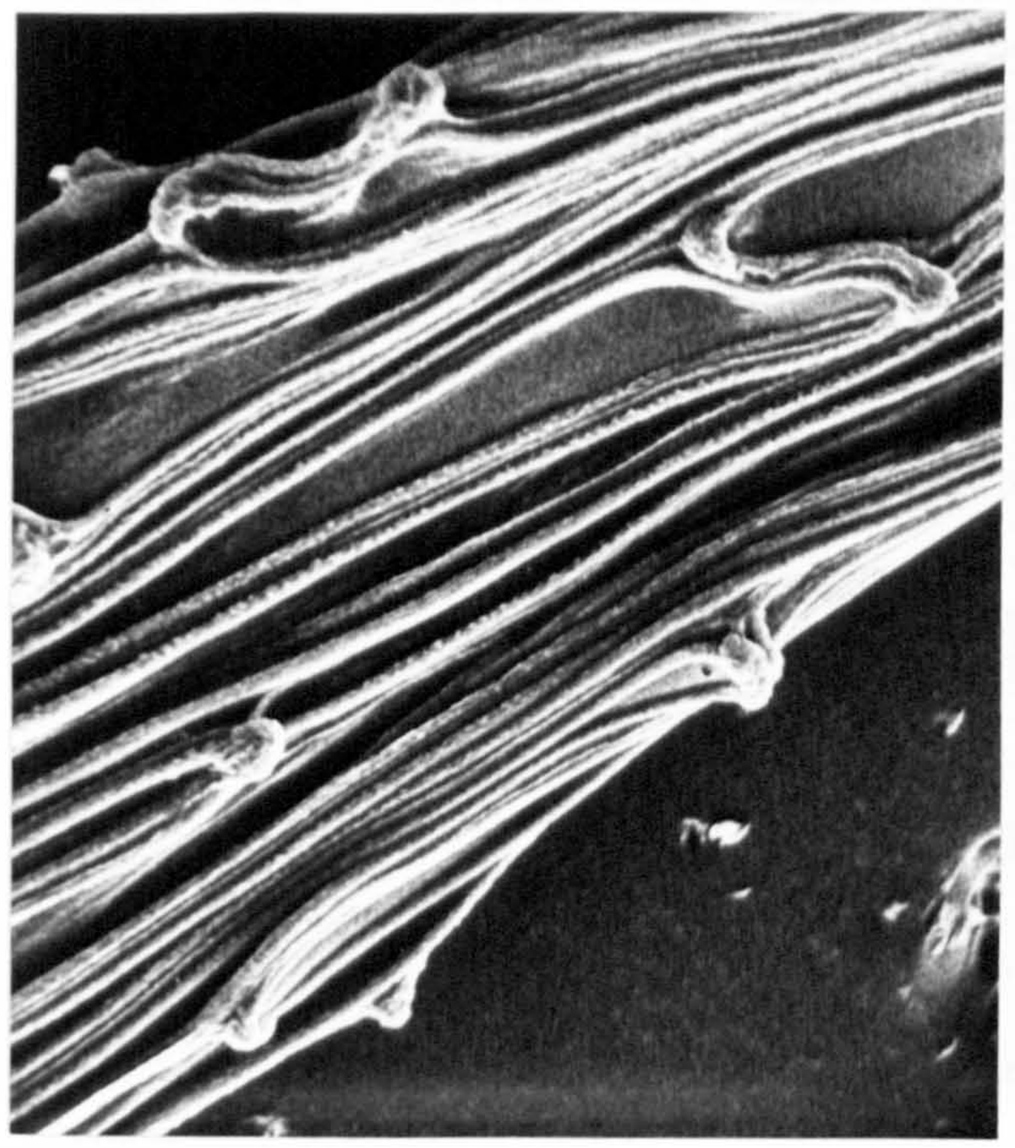


Figure 81 :
Tolumnia tetrapetala
(x1000)

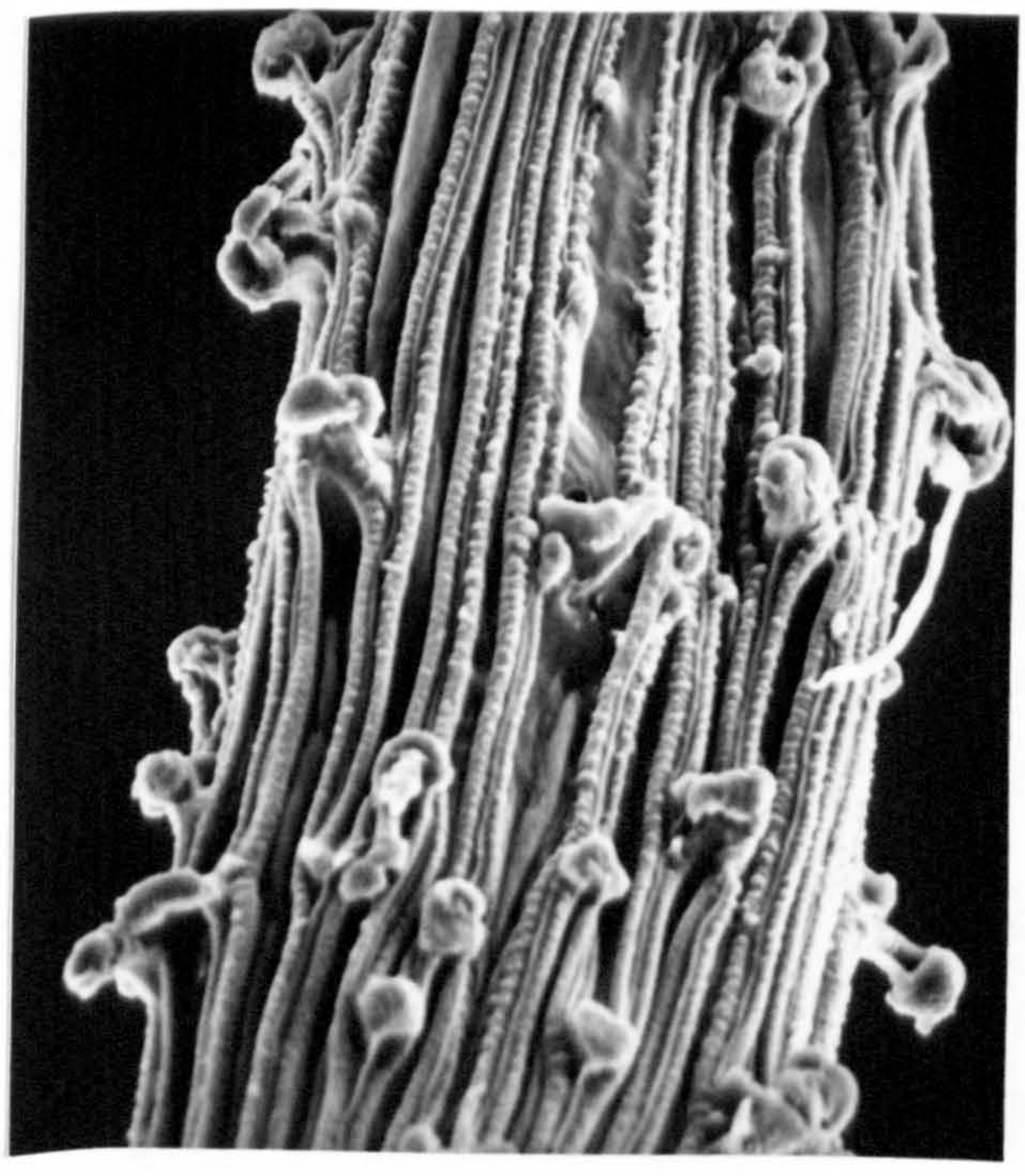


Figure 82 :
Tolumnia variegata
(x1000)

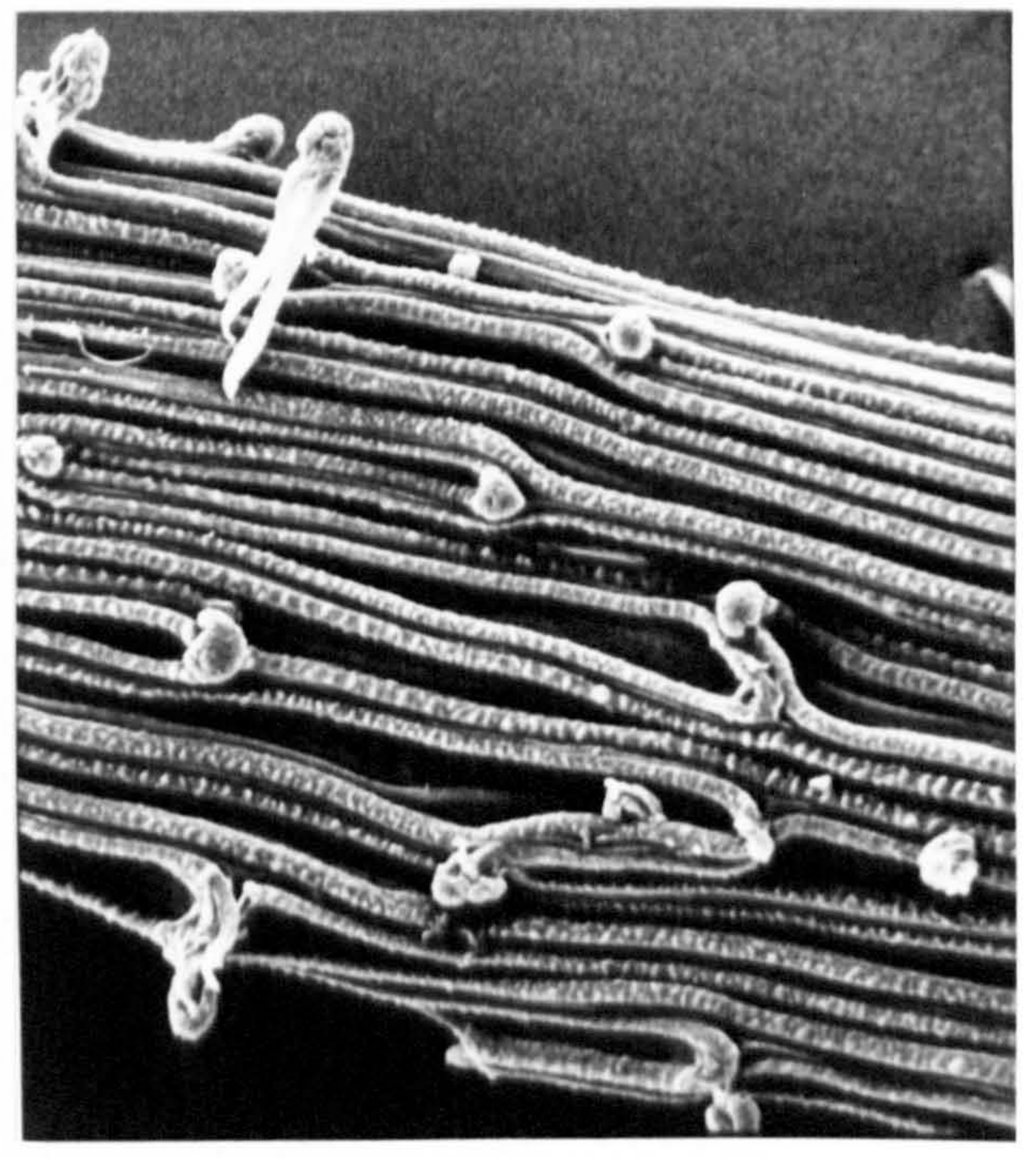


Figure 83 :
Tolumnia tuerckheimii
(x1000)

Figure 84 :
Rodriguezia lehmannii
(x2000)

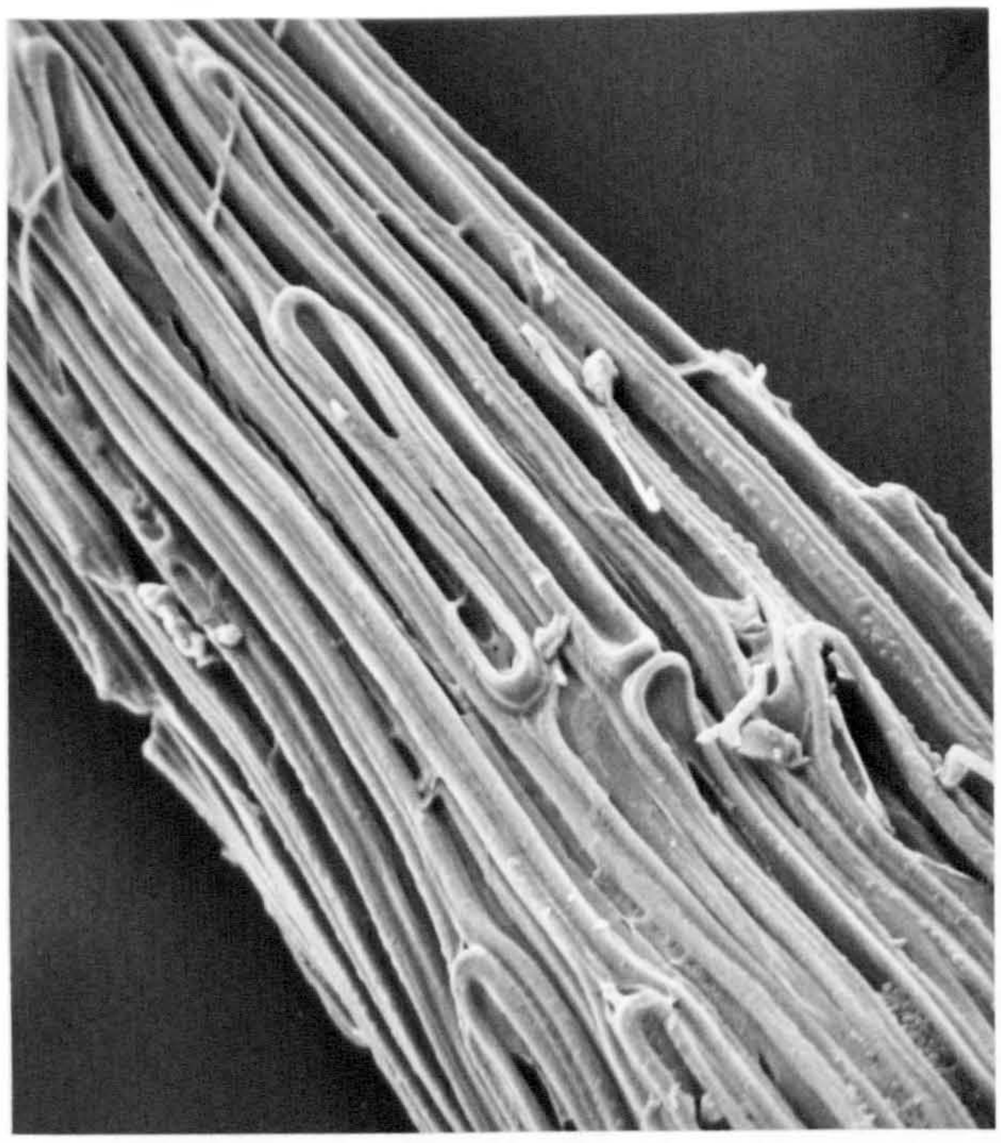


Figure 85 :
Comparettia falcata
(x1000)

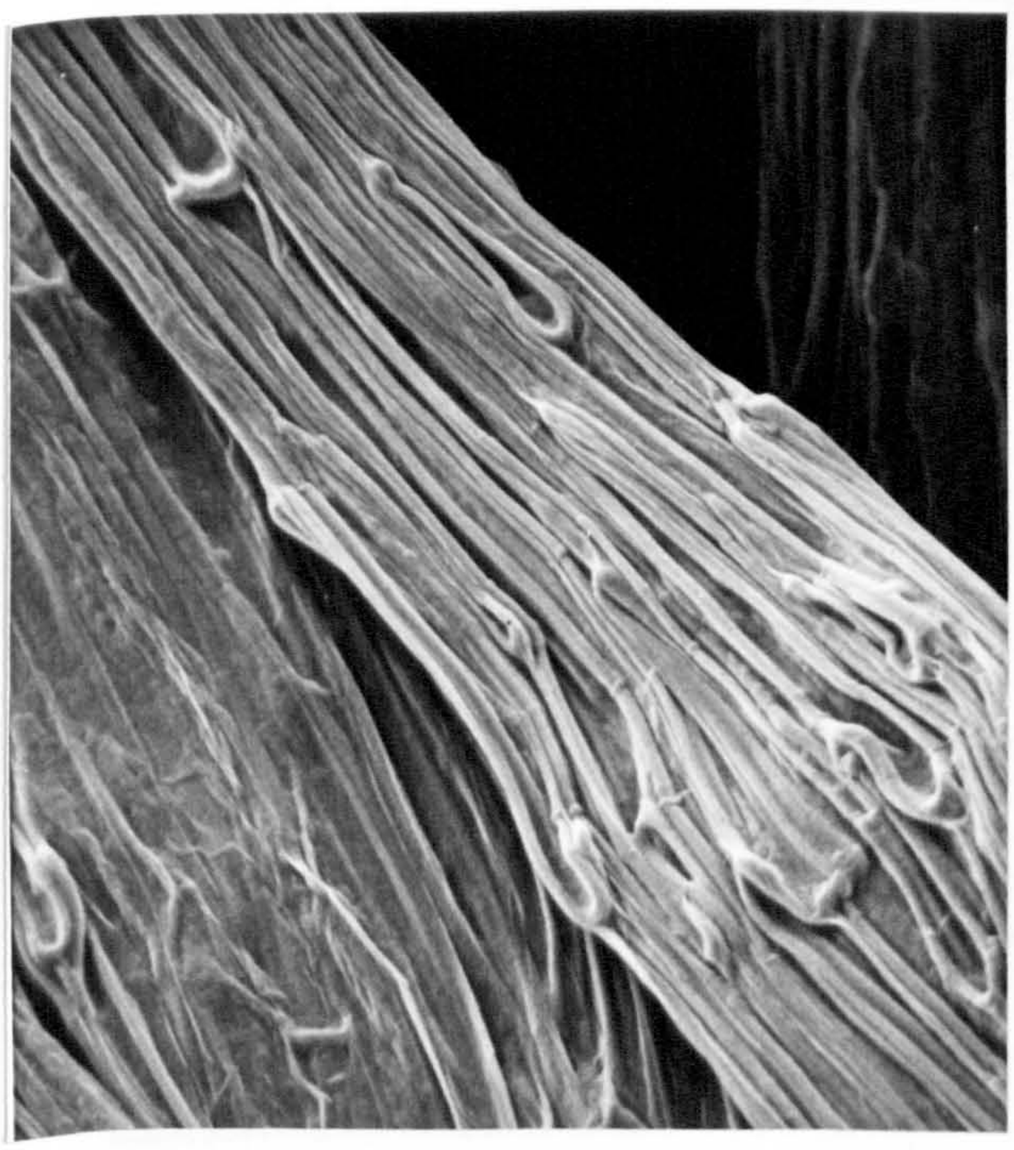


Figure 86 :
Ionopsis utricularioides
(x1500)

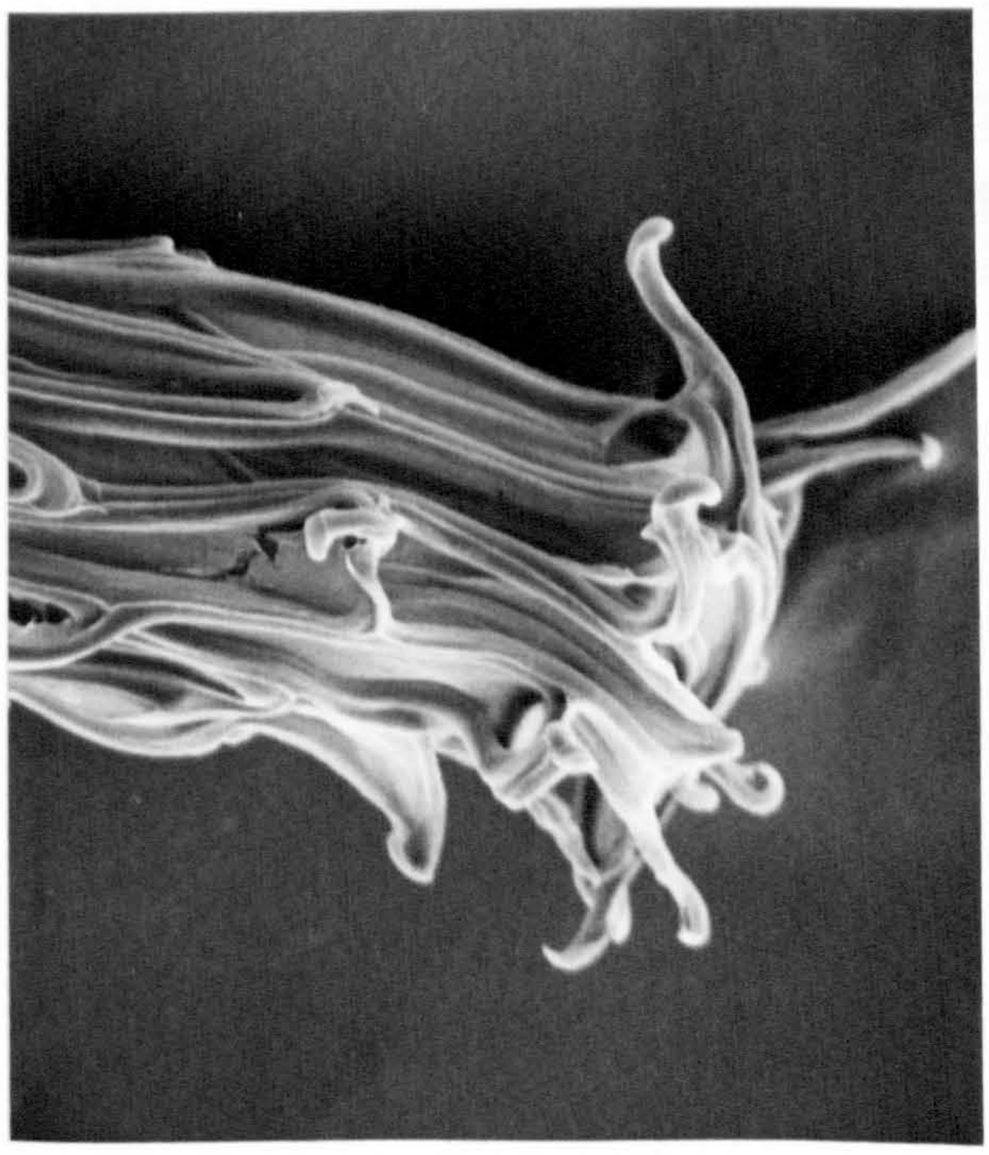


Figure 87 :
Psychopsis sanderae
(x400)

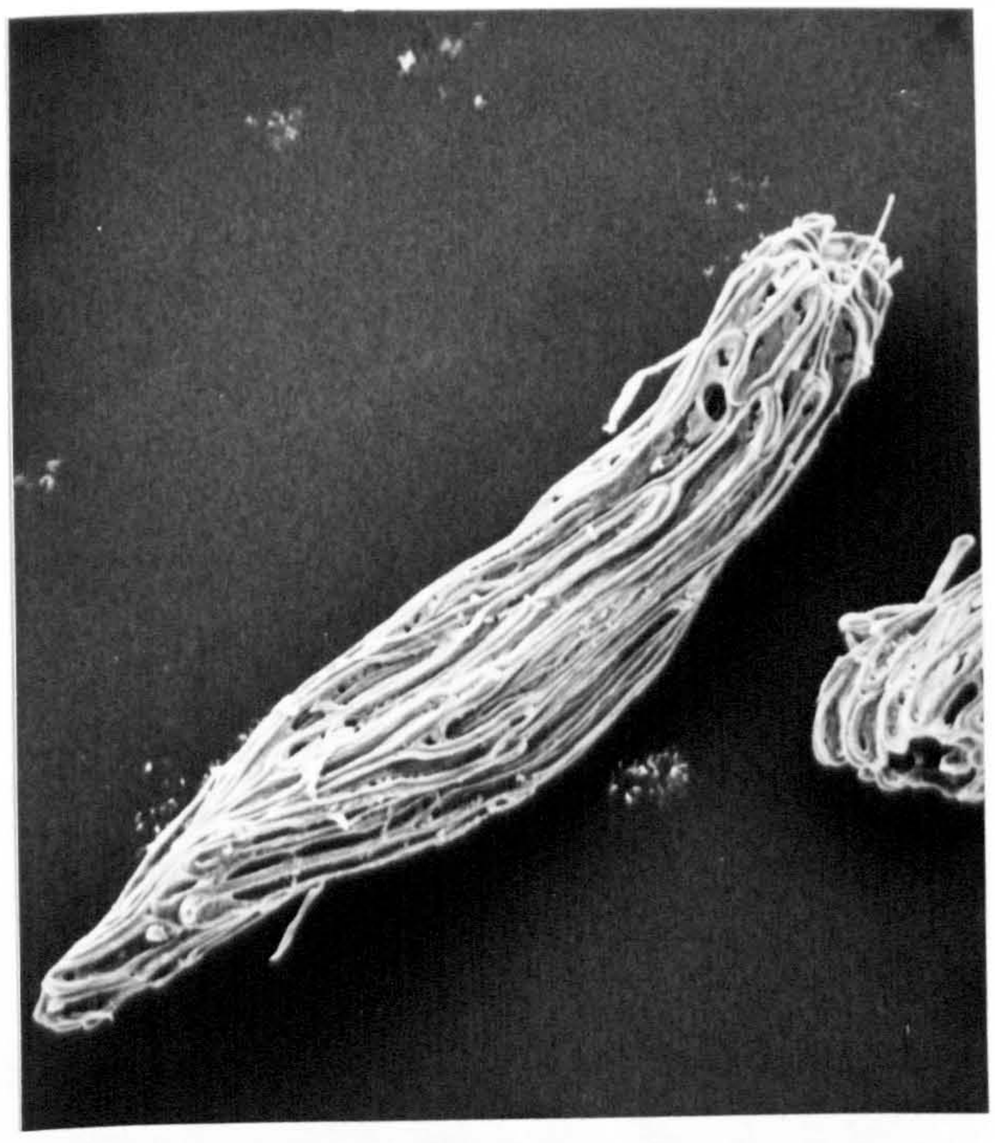


Figure 88 :
Odontoglossum maculata
(x1000)

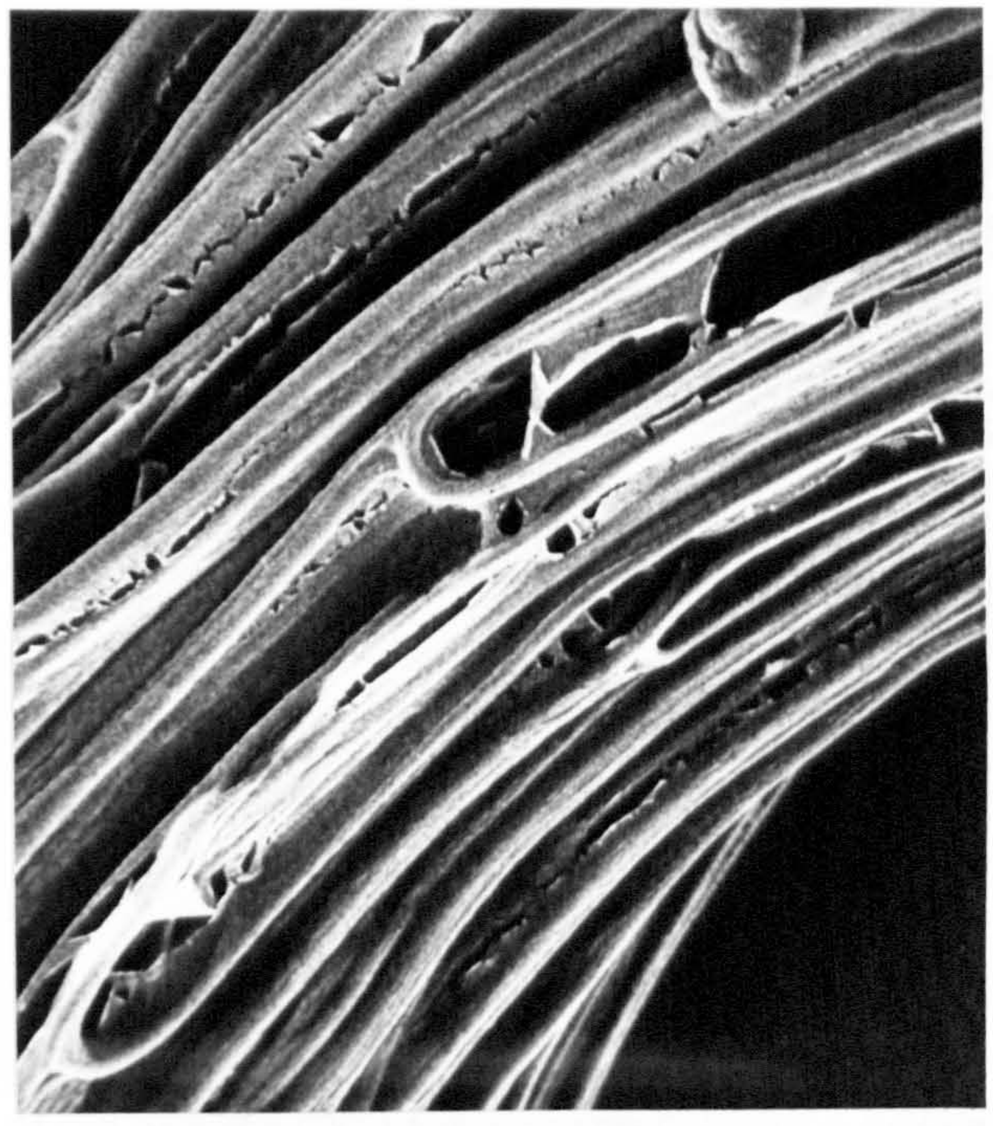


Figure 89 :
Maxillaria picta
(x300)

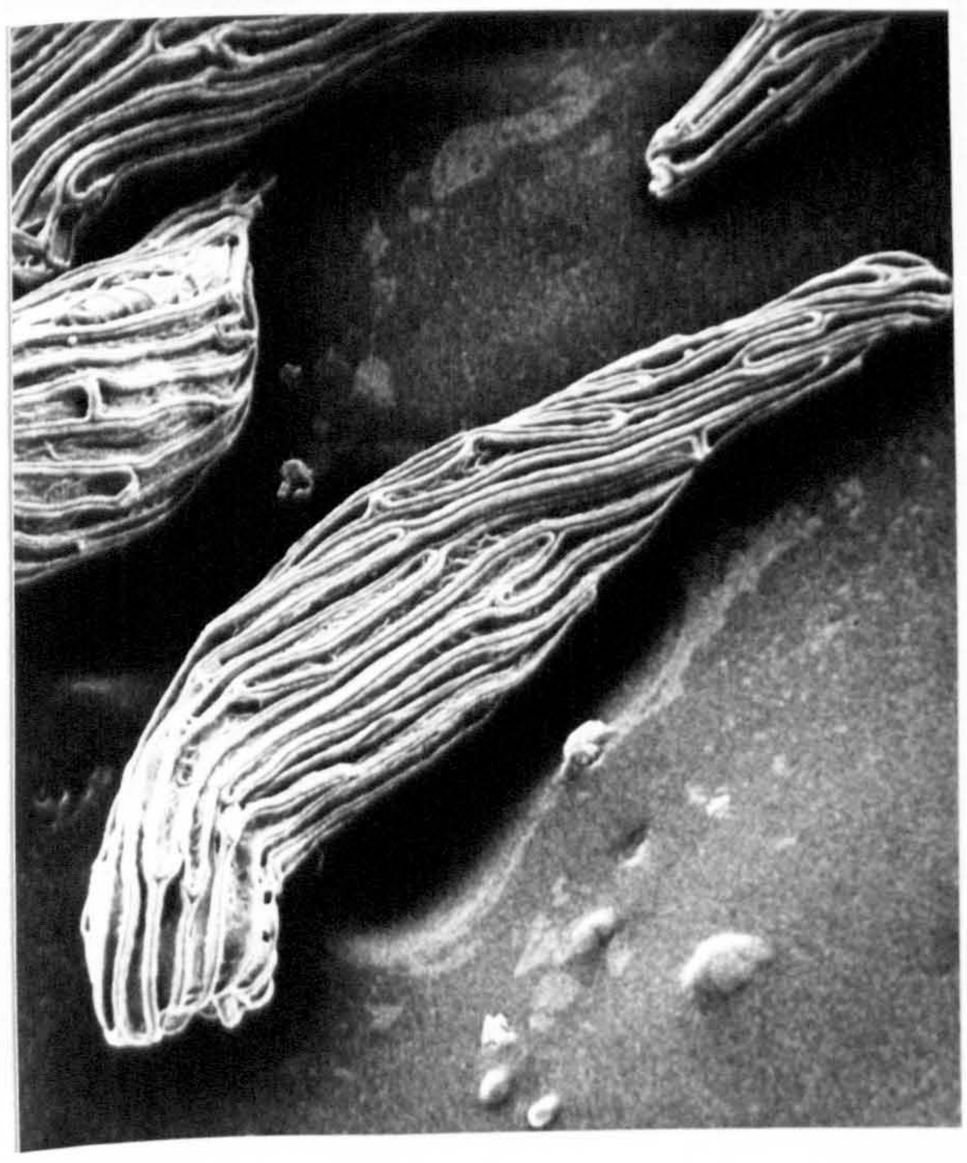


Figure 90 :
Maxillaria picta
(x1000)

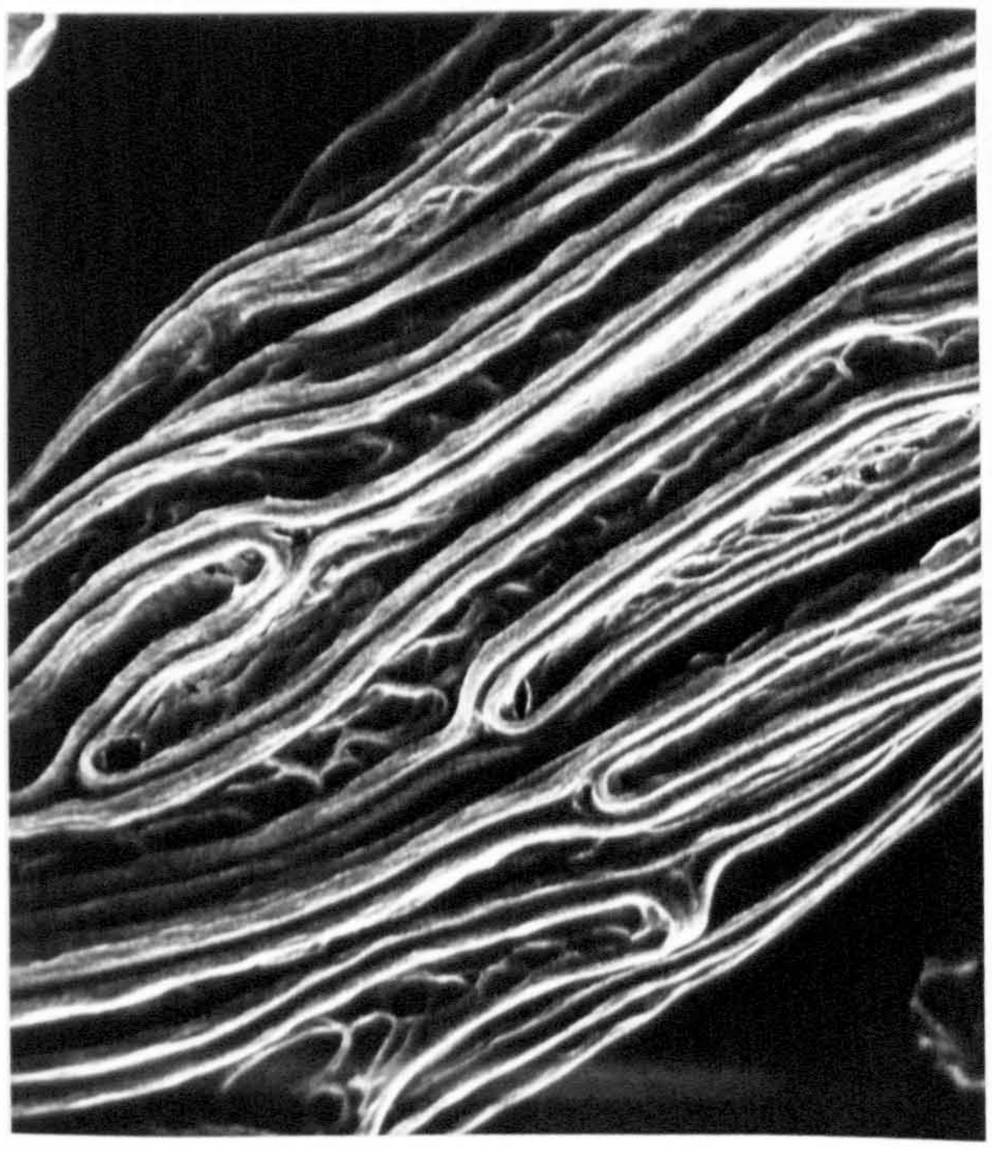


Figure 91 :
Oncidium macropetalum
(Sect. Crispa) (x1000)

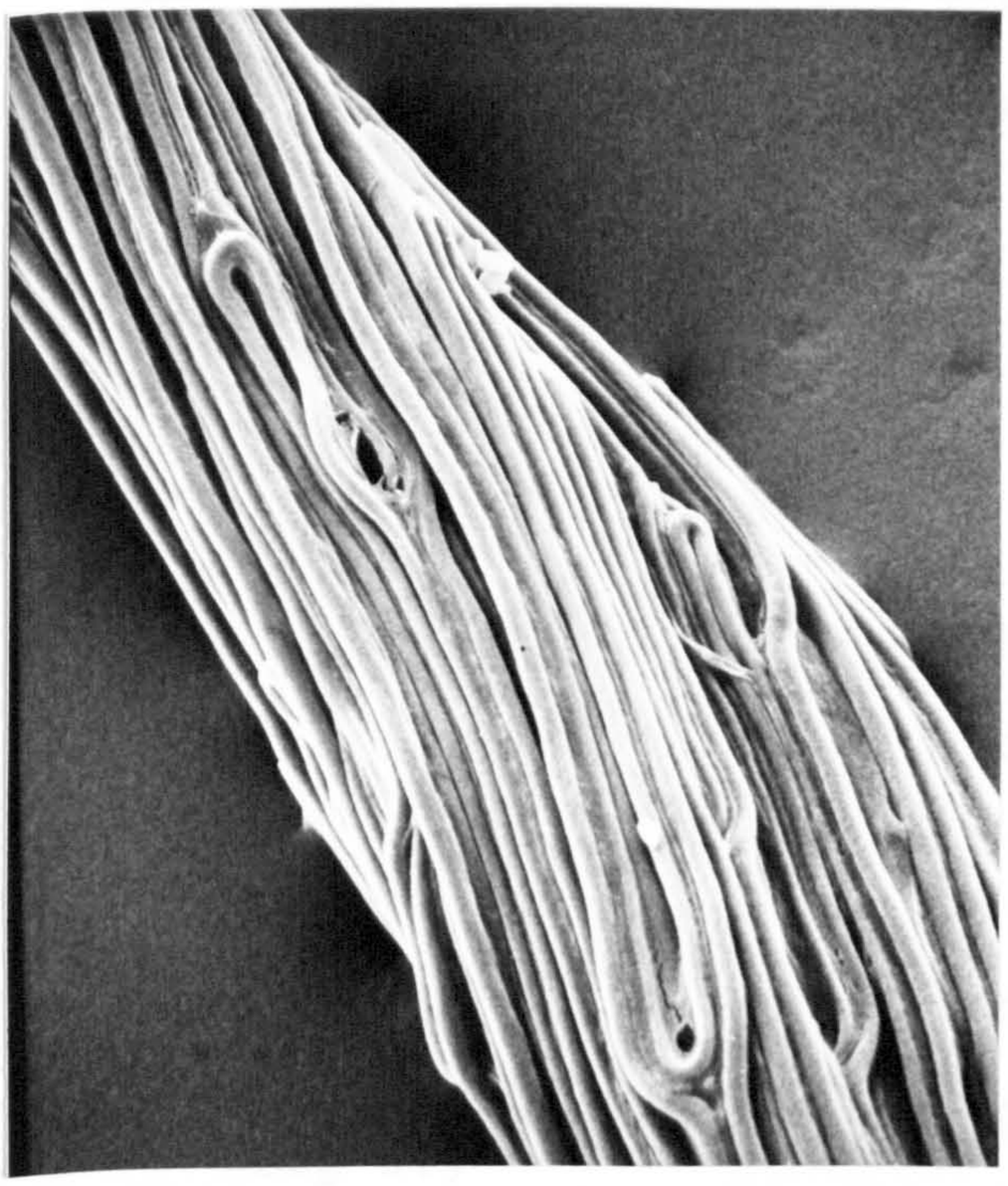


Figure 92 :
Oncidium hastatum
(Sect. Stellata) (x1000)

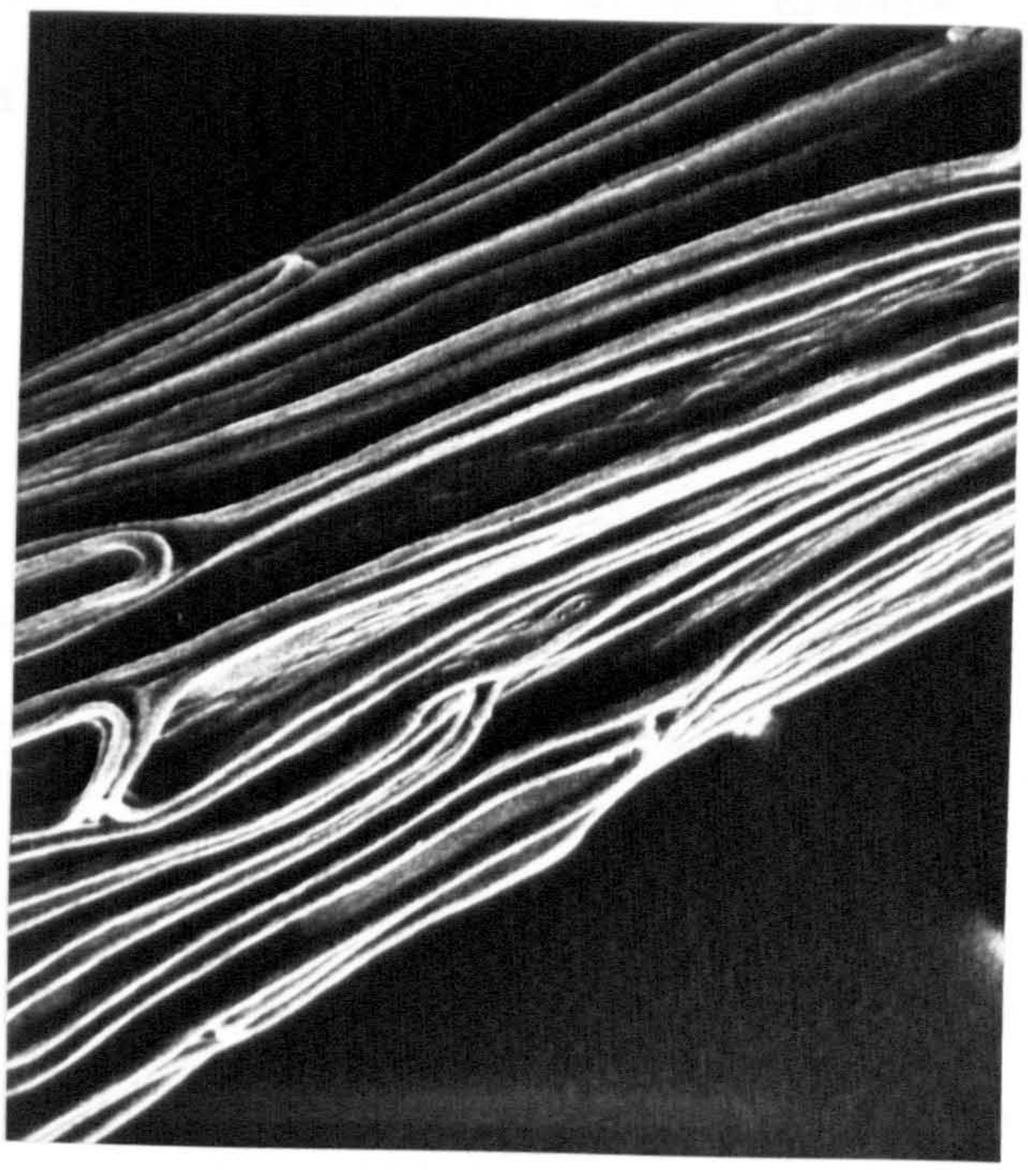


Figure 93 :
Oncidium cheirophorum
(Sect. Rostrata) (x1000)

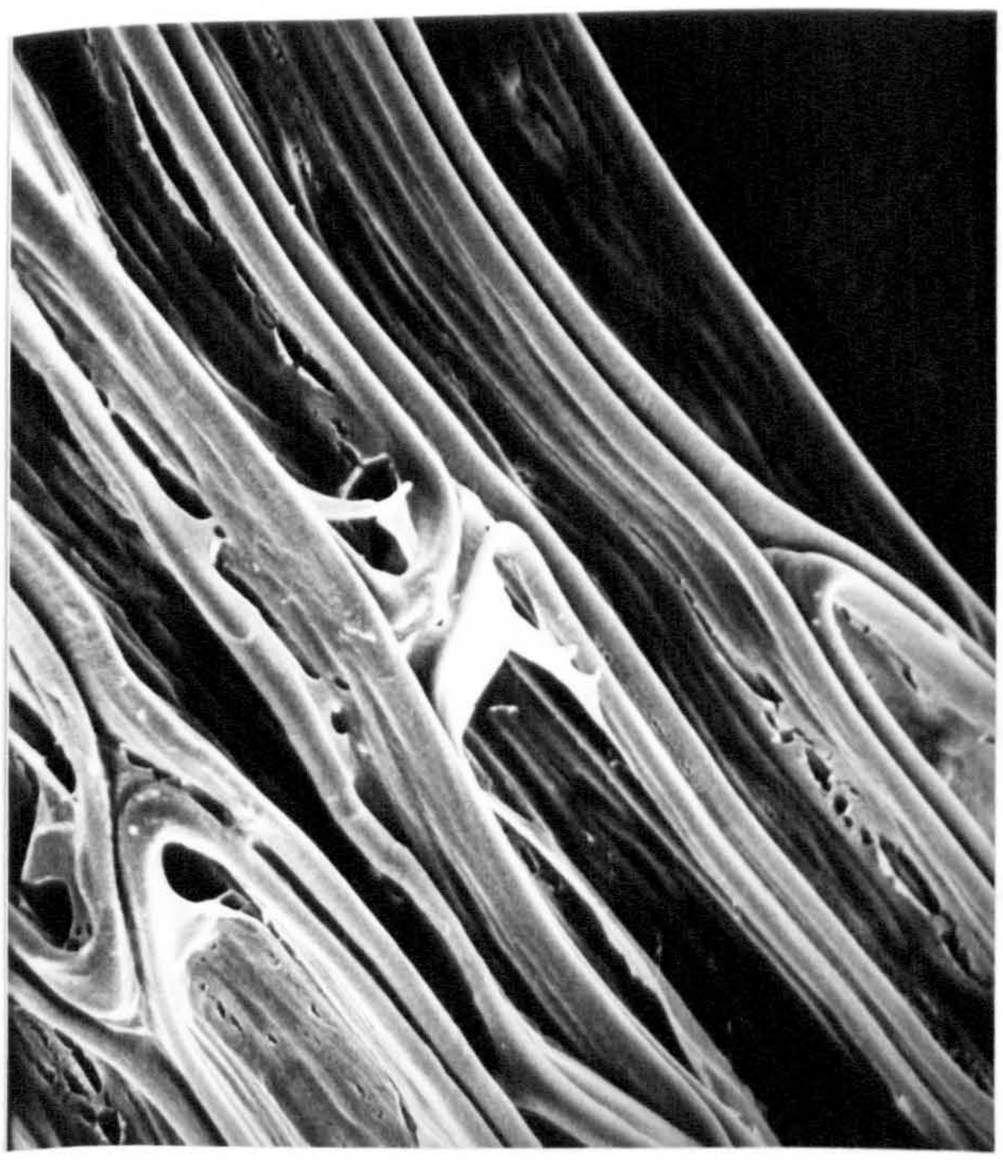
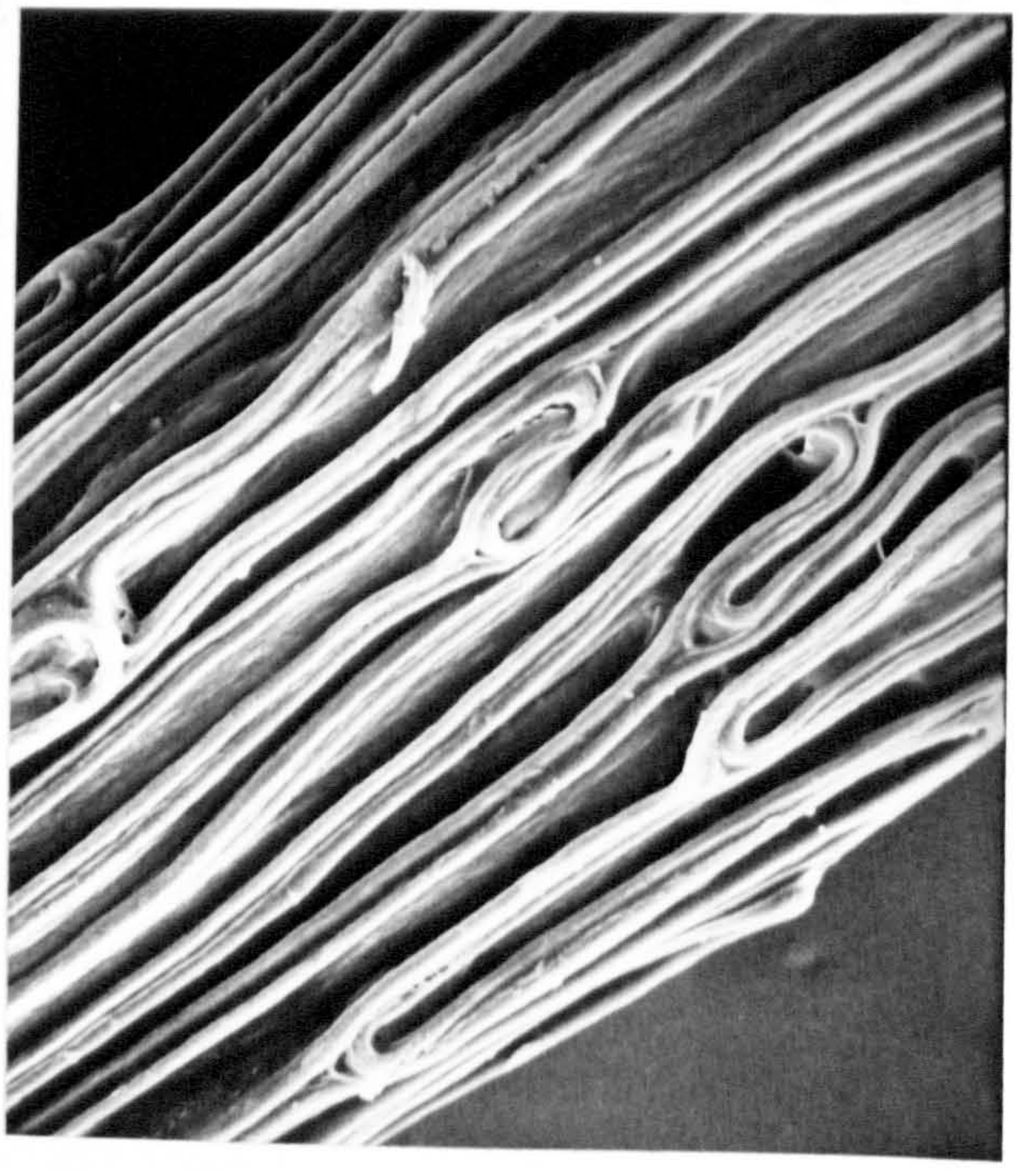


Figure 94 :
Oncidium pollardii
(Sect. Rostrata) (x1000)



Little is known about the nature of these raised parts of the cellular surface. Barthlott (personal communication) suggested that these structures are made of wax. However, after treatment with chloroform for several hours, the structures were not dissolved.

4. 4. 3. CONCLUSION

The studies on reproductive morphology have shown a number of good taxonomic criteria for differentiation within the group of plants under examination:

1.	Peduncle terete / flattened	1 / 0
2.	Flower morphology showing "insect mimicry" / not so (fig 3.)	1 / 0
3.	Callus at base of labellum present / not so (fig 44.)	1 / 0
4.	Callosities of crest fingerlike / not so (fig.45.)	1 / 0
5.	Basic colour of labellum yellow /not so	1 / 0
6.	Labellum unicoloured / spotted or striped	1 / 0
7.	Lateral petals much smaller than labellum / not so	1 / 0
8.	Lateral lobes of labellum much smaller than half of the apical lobe / not so	1 / 0
9.	Column wings hiding column completely /not so	1 / 0
10.	Synsepalum present / lateral petals free	1 / 0
11.	Pollinia type A / B	0 / 1
12.	Thickenings on cell borders of seed present / not present	1 / 0
13.	Seed capsule smooth and oblong / spheroid and spiny	1 / 0

For these 13 characters, the species of the "Variegata" can be scored for computing as follows. No important variation of any of these characters appears to occur within a species.

Table 14 : Scoring of characters of reproductive morphology of species belonging to the "Variegata" for computing purposes

	1	2	3	4	5	6	7	8	9	10	11	12	13
B. arizajuliana	1	0	1	0	0	0	1	1	1	0	0	1	1
H. henekenii	1	1	0	0	0	1	1	1	0	1	1	1	1
O. gauntlettii	1	0	0	0	0	1	1	1	0	1	1	1	1
O. triquetra	1	0	0	0	0	0	1	1	0	1	1	1	1
T. bahamensis	1	0	1	0	0	1	1	1	0	1	1	1	1
T. calochila	1	0	1	1	1	1	1	1	0	1	1	1	1
T. compressicaulis	0	0	1	0	1	0	1	1	0	1	1	1	1
T. quianensis	1	0	1	0	1	1	0	1	0	1	1	1	1
T. guia. alborub.	1	0	1	0	1	1	0	1	0	1	1	1	1
T. haitiensis	1	0	1	1	1	1	1	1	0	1	1	1	1
T. hawkesiana	1	0	1	0	0	1	1	1	0	1	1	1	1
T. leiboldii	1	0	1	0	0	1	1	1	0	1	1	1	1
T. lemoniana ssp. lemon.	1	0	1	0	1	0	1	1	0	1	1	1	1
T. lemoniana ssp. guib.	1	0	1	0	1	0	1	1	0	1	1	1	1
T. lucayana	1	0	1	0	0	0	1	1	0	1	1	1	1
T. x osmentii	1	0	1	1	1	1	1	0	0	1	1	1	1
T. prionochila	1	0	1	0	1	1	1	1	0	1	1	1	1
T. pulchella	1	0	1	0	0	1	1	1	0	1	1	1	1
T. quadrilobia	1	0	1	0	1	1	1	0	0	1	1	1	0
T. sasseri	1	0	1	0	0	1	1	1	0	1	1	1	1
T. scandens	1	0	1	0	0	1	1	1	0	1	1	1	1
T. sylvestris	1	0	1	0	0	1	1	1	0	1	1	1	1
T. tetrapetala	1	0	1	0	0	1	1	1	0	1	1	1	1
T. tuerckheimii	1	0	1	0	1	0	1	1	0	1	1	0	1
T. urophylla	1	0	1	0	1	1	1	1	0	1	1	1	1
T. usneoides	1	0	1	0	0	0	0	1	0	1	1	1	1
T. variegata	1	0	1	0	0	1	1	1	0	1	1	1	1
T. velutina	1	0	1	0	0	1	1	1	0	1	1	1	1

4. 5. CHROMOSOME NUMBERS

4. 5. 1. INTRODUCTION AND REVIEW OF PERTINENT LITERATURE

Plant chromosome numbers is a criterion which was examined as far back as the end of last century.

The first count within the Orchidaceae was reported by Strasburger (1888) who examined Cypripedium barbatum Lindley [now Paphiopedilum barbatum (Lindley) Pfitzer] and in the mean time, a large number of species within the family Orchidaceae have been examined and the counts duly reported. Two synopsis of the chromosome counts within the Orchidaceae have been published (Duncan 1959, Tanaka & Kamemoto 1984).

About 2000 species of orchids have been examined in respect to the number of their chromosomes (table 15), and assuming a total of 25,000 species, this is a very low percentage.

As might be expected, the chromosome numbers of the orchids from northern temperate regions and those tropical orchids which have a clear commercial value are best known. As far as the Oncidiinae are concerned, the majority are of no great commercial value and subsequently only few counts have been reported (tables 16 and 17)

Table 15 : Previously reported chromosome counts (2n) in tribes and subtribes of the Orchidaceae (after Tanaka and Kamemoto 1984)

Apostasioidea	144
Cypripedioideae	20,24,26,28,30,32,34,36,38,40,42
Spiranthoideae	
Erythrodeae	
Tropidiinae	40,56,60
Goodyerinae	20,22,26,28,30,32,40,42,44,56
Cranichideae	
Spiranthinae	24,26,30,44
Pachyplectroninae	?
Manniellinae	?
Cranichidinae	?
Cryptostylidinae	42
Orchidoideae	
Neottiae	
Limodorinae	32,34,36,40,48,64
Listerinae	34,36,38,40,42,56
Diurideae	
Chloraeinae	?
Caladeniinae	?
Pterostylidinae	?
Acianthinae	?
Diuridinae	26
Prasophyllinae	44
Orchideae	
Orchidinae	30,32,36,38,40,42
Habenariinae	28,32,36,42
Huttonaeinae	?
Diseae	
Disinae	?
Satyriinae	?
Coryciinae	?
ANOMALOUS TRIBES:	
Triphoreae	44
Wullschlaegelieae	?
Epidendroideae	
Vanilleae	
Vanillinae	28,32
Lecanorchidinae	?
Palmorchidinae	?
Pogoniinae	18
Gastrodieae	
Nerviliinae	54,72,108,144
Gastrodiinae	16,18,36,40,150
Rhizanthellinae	?
Epipogieae	68
Arethuseae	
Arethusinae	?
Thuniinae	42
Bletiinae	32,36,38,40,42,44,48,50,58
Sobraliinae	?
Coelogyneae	

Coelogyninae	40
Adrorhizinae	?
Malaxideae	20,26,28,30,38,42,44
Cryptarrheneae	?
Calypsoeae	28,32
Epidendreae	
Eriinae	36,38,40,44
Podochilinae	?
Thelasiinae	?
Glomerinae	?
Laeliinae	24,40,56
Meiracylliinae	?
Pleurothallidinae	32,42,44,64
Dendrobiinae	38,40
Bulbophyllinae	36,38,40
Sunipiinae	?
Vandoideae	
Polystachyeae	40
Vandeae	
Sarcanthinae	24,38,40
Angraecinae	38,40,42
Aerangidinae	46,50
Maxillarieae	
Corallorhizinae	36,40,42,46,48,50
Zygopetalinae	46,48
Bifrenariinae	38,40
Lycastinae	40
Maxillariinae	40,48
Dichaeinae	52
Telipogoninae	?
Ornithocephalinae	?
Cymbidieae	
Cyrtopodiinae	32,36,38,40,42,54,56
Genyorchidinae	?
Thecostelinae	?
Acriopsidinae	?
Catasetinae	54,64,68
Stanhopeinae	38,40,42
Pachyphyllinae	?
Oncidiinae	10,14,24,26,28,29,30,36,37,38, 40,42,44,48,50,56,59,60,84,86, 105-111,112,126,133

Figure 95 : Frequency of chromosome numbers (2n) in the Orchidaceae.

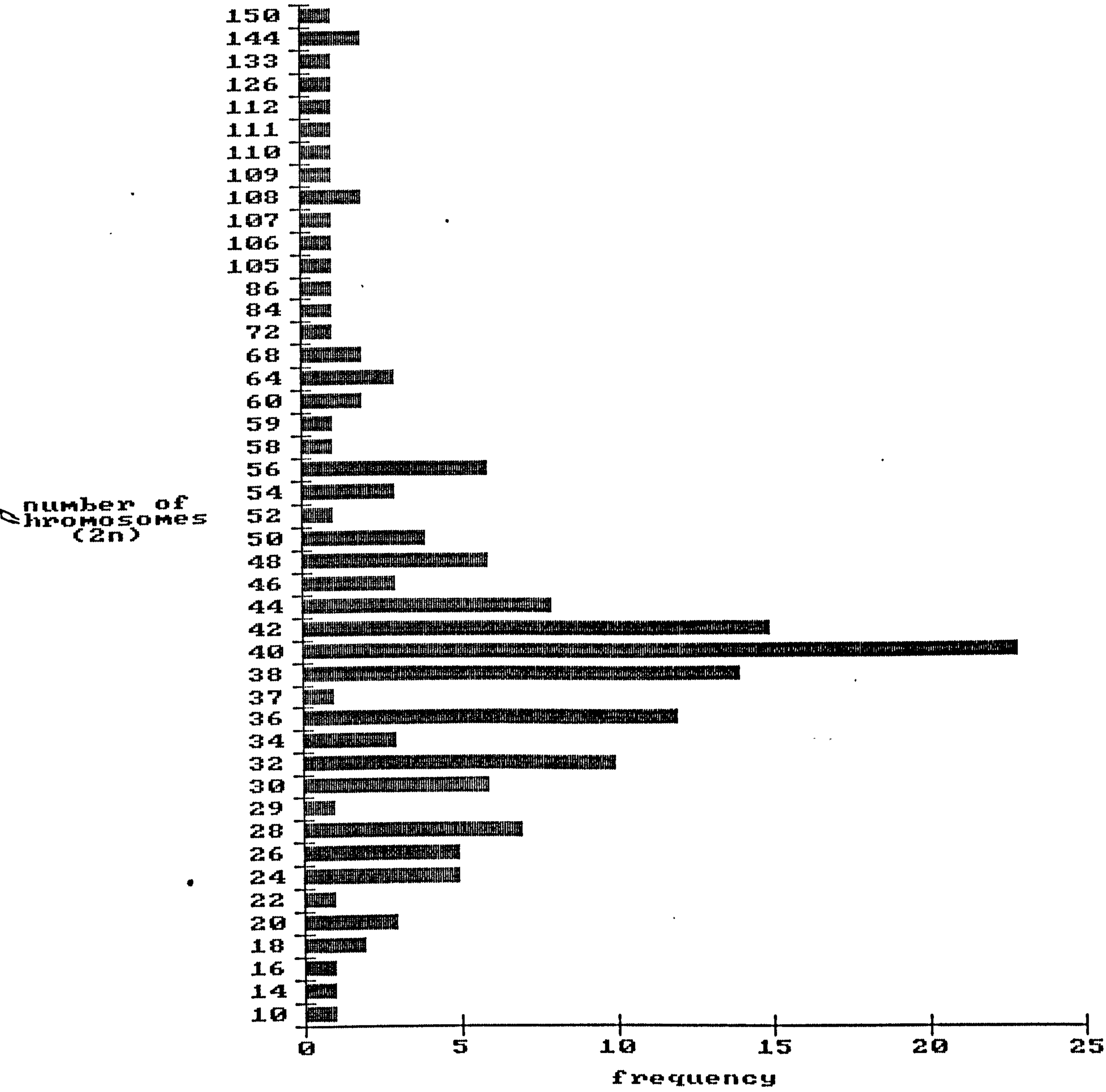


Table 16 : Previously reported chromosome counts (2n) in the subtribe Oncidiinae (after Tanaka & Kamemoto 1984, modified).

Ada	60
Amparoa	?
Antillanorchis	?
Aspasia	56,58,60
Baptistonia	56
Braasiella	42
Brachtia	?
Brassia	50,52-56,52-58,56,60
Capanemia	?
Caucaea	?
Cischweinfia	?
Cochlioda	?
Comparettia	42,44
Cypholoron	?
Diadenium	?
Erycina	52,56
Gomesa	56
Helcia	?
Hispaniella	40
Hybochylus	?
Ionopsis	46
Leochilus	?
Lockartia	14,56
Macradenia	48,52
Mesospinidium	?
Mexicoa	?
Miltonia	56,59,60,86
Miltoniopsis	56,60
Neodryas	?
Neokoehleria	?
Notylia	42
Odontoglossum	44,44-48,56,60?
Olgasis	42
Oliveriana	?
Oncidium sensu Braem	24,26,28,30,32,34,36,37,ca. 40, 40-42,42,44,ca. 48,50-57, 52, ca. 52,54,55-57,56,58,72,105-111, 112,140-150,168
Ornithophora	56
Otoglossum	?
Palumbina	?
Papperitzia	?
Plectrophora	?
Polyotidium	?
Psychopsiella	56
Psychopsis	38
Psygmorchis	10,14
Pterostemma	?
Quekettia	?
Rodriguezia	28,29,42
Rodrigueziopsis	?
Rossioglossum	44,60(?)
Rusbyella	?
Sanderella	?
Saundersia	?

Scelochilus	?
Sigmatostalix	60
Solenidium	?
Symphyglossum	?
Systeloglossum	?
Tolumnia	40,42,84,126,133
Trichocentrum	24,28
Trichopilia	56
Trizeuxis	?
Warmingia	?

Figure 96 : Frequency of chromosome numbers (2n) in the subtribe Oncidiinae.

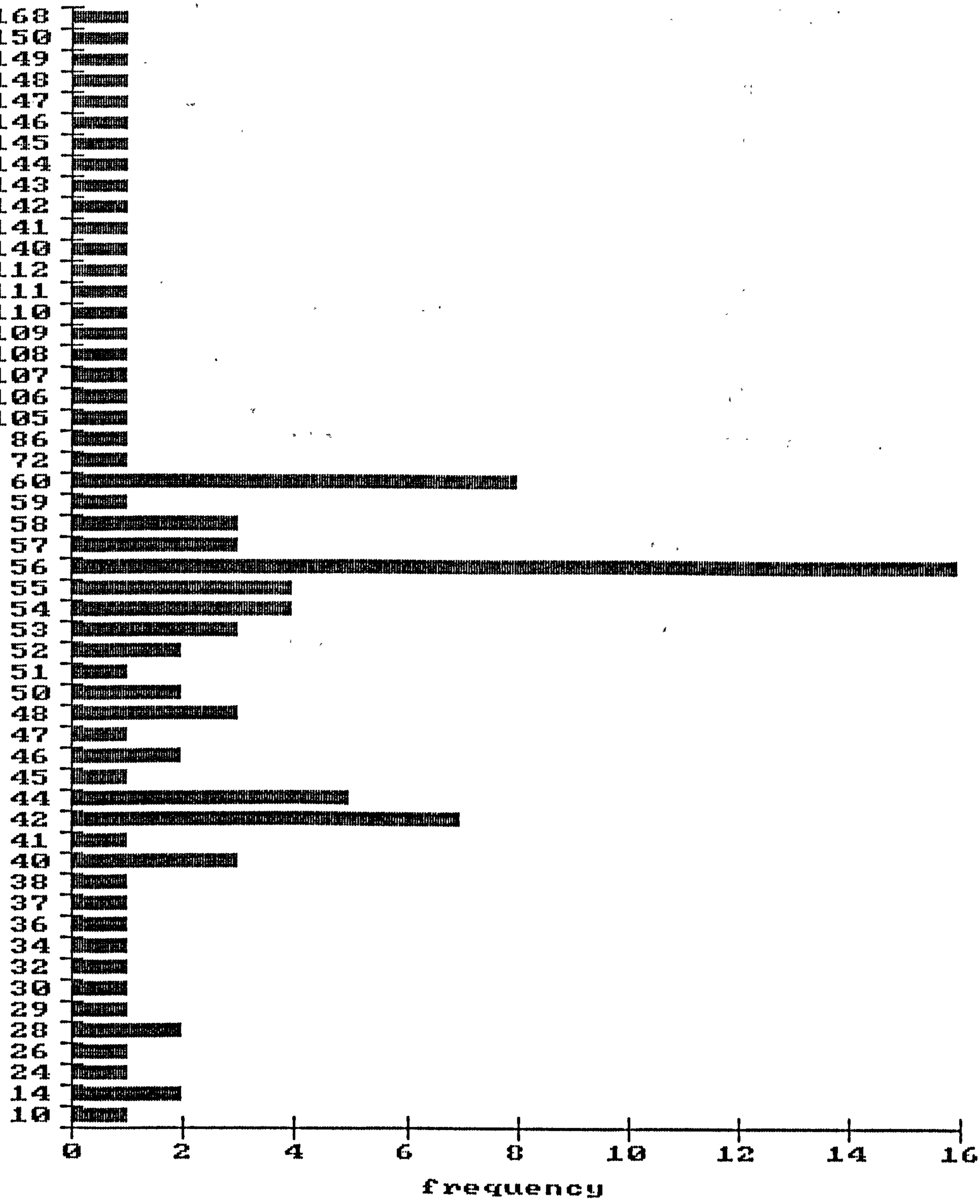
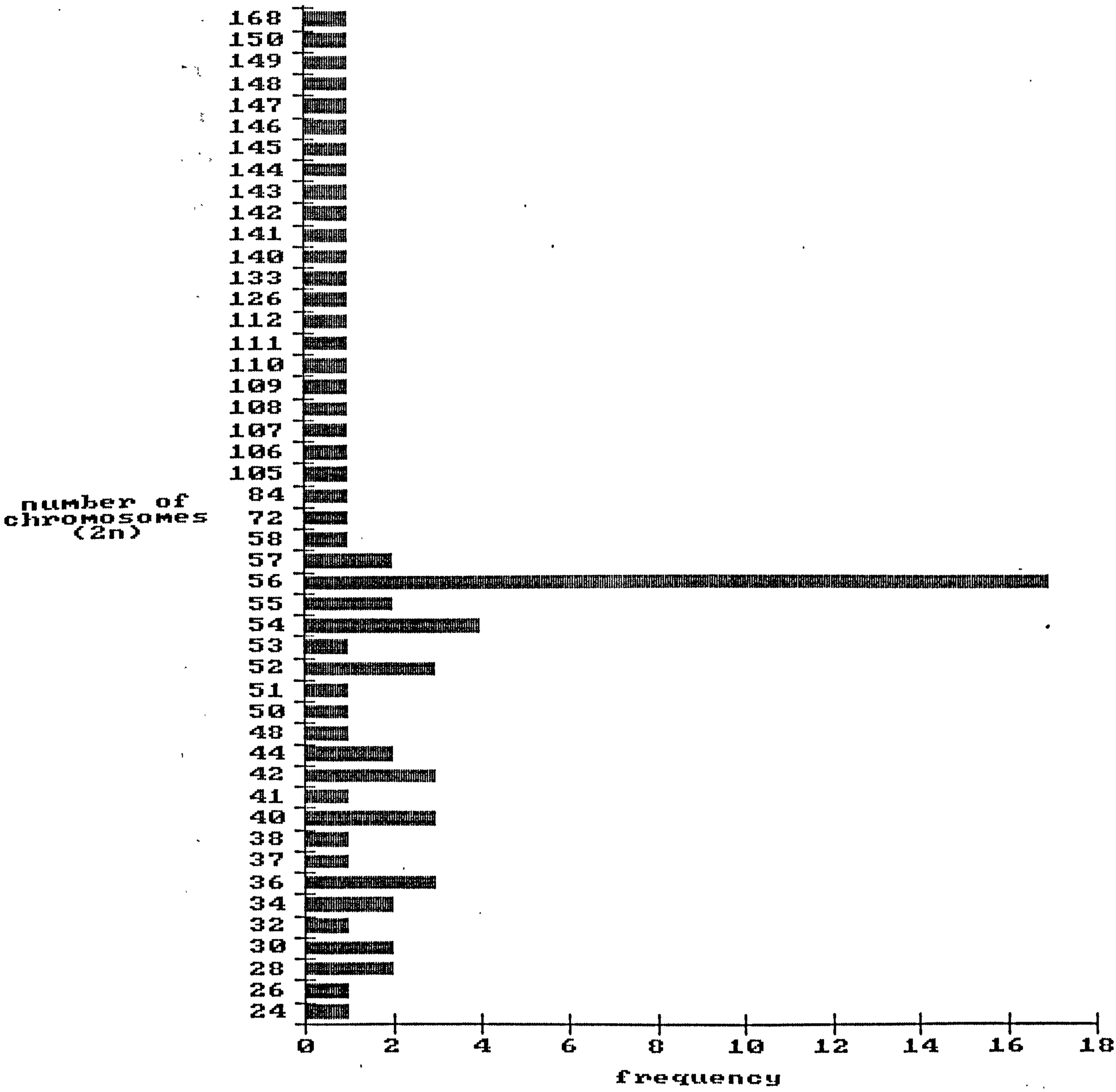


Table 17 : Previously reported chromosome counts (2n) within the genus Oncidium sensu Garay & Stacy (after Tanaka and Kamemoto 1984).

	2n
Section Barbata	56
Section Cebolletae	28,30,34,36,72
Section Cimicifera	?
Section Concoloria	56
Section Crispa	52,56,58
Section Cucullata	54,56
Section Cyrtochilum	36,37,50-57, 55-57,56
Section Disticha	?
Section Excavata	54,56
Section Glanduligera	38,56
Section Heterantha	40-42
Section Oblongata	44,54,56
Section Oncidium (= "Variegata")	40,42,84,126,133
Section Onusta	56
Section Paucituberculata	?
Section Planifolia	ca. 52,56,105-111
Section Planilabria	56
Section Plurituberculata	24,26,28,30,32,34, 36,ca. 40
Section Pulvinata	42,44
Section Rhinocerotes	?
Section Rostrata	ca 48,56
Section Serpentia	56
Section Stellata	56
Section Synsepala	56,112,140-150,168
Section Verrucituberculata	?
Section Waluewa	?

Figure 97 : Frequency of chromosome numbers (2n) in the genus Oncidium sensu Garay and Stacy.



The chromosome number in any one orchid species is generally constant. Therefore, different counts can indicate different species.

In some cases however, a duplication, triplication or further multiplication of diploid chromosome sets can indicate a tetraploid or other polyploid state which does not always indicate the appearance of a different species.

Diploids and polyploids cannot be always distinguished morphologically (as in Tolumnia variegata 2n = 42 and Tolumnia velutina 2n = 84). Although it is usually assumed that the plants of different ploidy levels are reproductively isolated from each other, hybrids being sterile due to their faulty meiosis, this is not always the case, as in hybrid swarms between diploid and tetraploid Dactylorhiza (Lord and Richards 1977).

The Oncidiinae show a great variety in chromosome counts. Up till now, chromosome counts for about 250 species within the subtribe have been reported (Tanaka & Kamemoto 1984).

Both five and seven have been suggested as base (haploid) numbers for this group (Sinoto 1962, Charanasri & Kamemoto 1975), but Dressler (1981) questions the possibility of such a low count - which is a primitive feature - in such highly evolved orchids. He suggests that the low counts of 10 and 14 observed in the genus Psygmorchis are the result of a reduction in the base number through centromere loss as is known to occur in many short-lived plants.

As far as the "Variegata" are concerned, the first counts were reported in 1958 by Dodson. Since then, a number of further counts have been published but there are still considerable

gaps in the information, especially because of the fact that a considerable part of the data in some publications (Sinoto 1969, Charanasri 1975) appears to be taken from earlier ones. Within the "Variegata", the chromosome numbers of 10 taxa were unknown at the beginning of this study. For nine of these taxa, the chromosome numbers (2n) are now reported for the first time.

The known data indicates the predomination of 2n = 40,42,84 and therefore shows definite polyploidy within the group. For Tolumnia variegata and Tolumnia leiboldii two different counts (2n = 40,42) have been reported which might indicate some variation within those species or may be an expression of the difficulties of chromosome counting within this group of orchids.

Whether the count of 2n = 40 indicates that some species have lost two chromosomes could not be ascertained.

Table 18 : Previously reported chromosome counts (2n) within the "Variegata"

	DODSON	KUGUSTO	SINOTO	SINOTO	CHARANAS RI	CHARANAS RI	PHANG
	1958	1966	1962	1969	1973	1975	1979
B. arizajuliana	-	-	-	-	-	-	-
H. henekenii	-	-	40	40	40	40	-
O. gauntlettii	-	-	-	-	-	-	-
O. triquetra	42	-	42	42	42	-	42
T. bahamensis	-	-	84	-	84	84	-
T. calochila	-	-	-	-	-	42	-
T. compressicaulis	-	-	-	-	-	-	-
T. guianensis	-	40	40	40	40	40	-
T. haitiensis	-	-	-	-	-	-	-
T. hawkesiana	-	-	133	133	-	-	-
T. leiboldii	42	40	42	42	-	42	-
T. lemoniana ssp. lemoniana	-	-	-	-	-	42	-
T. lemoniana ssp. guibertiana	-	-	-	-	-	-	-
T. lucayana	-	40	40	-	40	40	-
T. x osmentii	-	-	-	-	-	-	-
T. prionochila	-	-	-	-	-	-	-
T. pulchella	42	42	42	42	42	-	-
T. quadrilobia	-	-	-	-	-	40	-
T. sasseri	-	-	-	-	-	-	-
T. scandens	-	-	84	84	-	84	-
T. sylvestris	-	-	84	84	-	126	-
T. tetrapetala	42	-	-	-	-	-	-
T. tuerckheimii	-	-	-	-	-	-	-
T. urophylla	-	-	84	84	-	84	-
T. usneoides	-	-	-	-	-	-	-
T. variegata	42	-	40	40	42	42	42
T. velutina	-	-	-	-	84	-	-

4. 5. 2. CHROMOSOME COUNTING

4. 5. 2. 1. MATERIALS AND METHODS

4. 5. 2. 1. 1. PREPARATION OF 8-HYDROXY-QUINOLINE SOLUTION

Pretreatment of root tips with 8-hydroxy-quinoline causes contraction of the chromosomes and improves their spreading due to the disturbance of the mitotic spindle and therefore facilitates the counting.

A 0.002 molar solution of 8-hydroxy-quinoline (MW = 145.15) was prepared by dissolving 0.029 of 8-hydroxy-quinoline in 100 ml of distilled water.

4. 5. 2. 1. 2. FIXATIVE

The fixation fluid should kill the cells rapidly with as little cell shrinkage, swelling, and distortion as possible. I have used Carnoy's solution made up out of 3 parts absolute ethanol and one part glacial acetic acid.

The fixative was always made freshly shortly before usage.

4. 5. 2. 1. 3. HYDROCHLORIC ACID

In order to soften the tissues for easy spreading, root tips were treated with 1 N. HCl at 60° C. for 7 minutes.

4. 5. 2. 1. 4. FEULGEN STAIN

a) 2.0 g. of basic fuchsin was dissolved in 400 ml of boiling water.

b) The solution was stirred and allowed to cool down to 50° C.

c) The solution was filtered and 60 ml of 1 N HCl and 6 g. of potassiummetabisulfite ($K_2S_2O_5$) were added to the filtrate.

d) The solution was allowed to bleach for at least 24 hours in a tightly closed brown bottle in the dark.

e) 1.0 g. of decolourizing carbon was added and the solution was shaken for 5 minutes and filtered. This procedure was repeated until the solution was perfectly clear.

f) The fixative was stored in a tightly stoppered bottle in the dark.

4. 5. 2. 1. 5. ROOT SQUASH TECHNIQUE FOR COUNTING CHROMOSOMES WITHIN THE ONCIDIINAE

a) Dividing root tips were cut from plants between 8:00 and 11:00 am.

b) The root tips were pretreated in 0.002 M 8-hydroxy-

quinoline for 4 hours at room temperature.

c) The 8-hydroxy-quinoline was removed and the root tips were rinsed in distilled water.

d) The root tips were fixed in Carnoy's solution at room temperature for 24 hours.

At this stage, the procedure was continued immediately or the vials with the specimens were transferred to the freezer after the Carnoy's solution was exchanged for 70% ethanol. The storage temperature was -18° C.

e) The fixative or ethanol was removed and the root tips were rinsed once more with distilled water (when the vials were handled after storage in the freezer, they were first brought up to room temperature before proceeding).

f) The root tips were hydrolized with 1 N HCl at 60° C. for 7 minutes.

g) The root tips were rinsed extensively with distilled water.

h) The distilled water was removed completely and the root tips were submerged in Feulgen's stain.

i) The root tips were squashed in a drop of aceto-car-

mine and the preparation was examined under the micros-
cope.

4. 5. 2. 2. RESULTS

Figures 98 to 122 show photographs of diploid chromosome sets in dividing root-tips. All photographs were taken when using immersion oil. The enlargement factor for all photographs is x 1425.

Figure 98 :
Braasiella arizajuliana
2n = 42

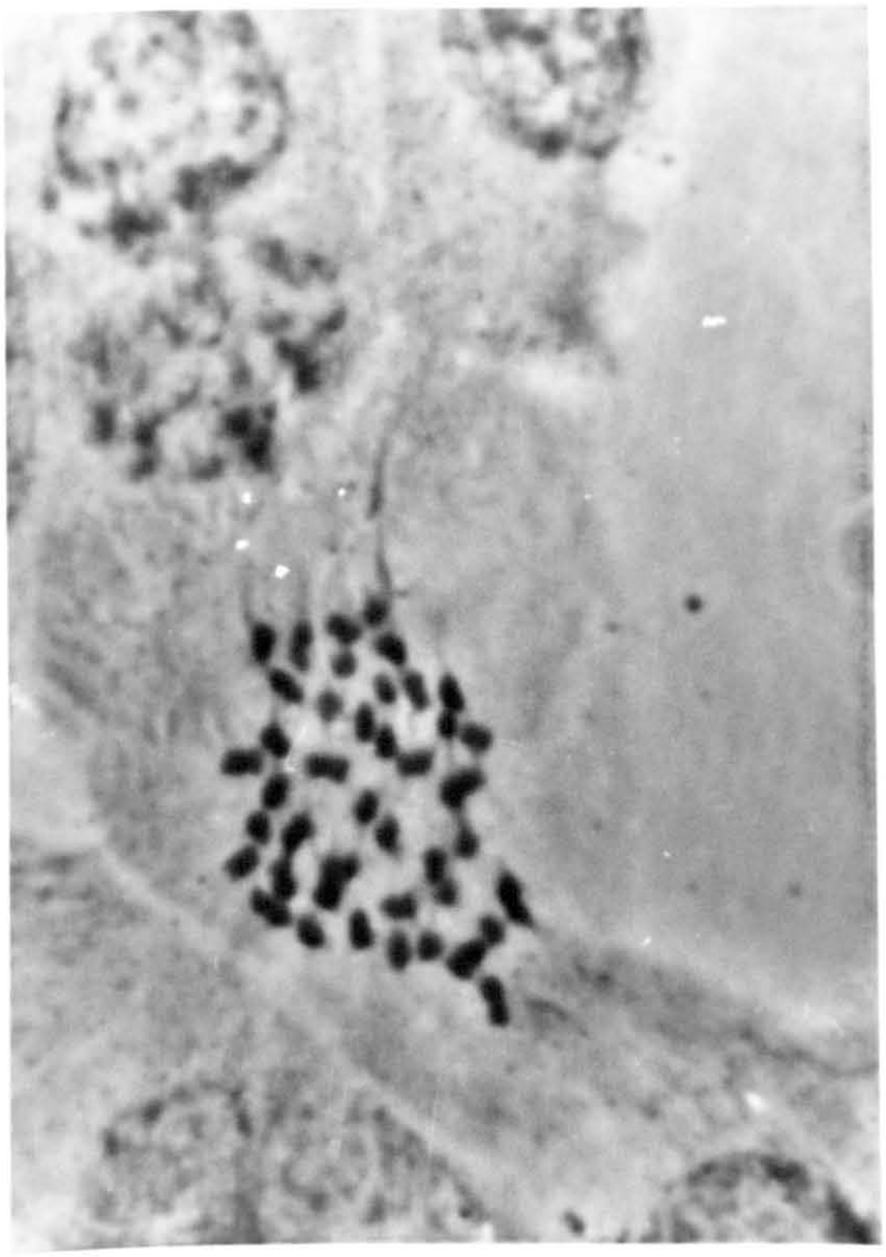


Figure 99 :
Hispaniella henekenii
2n = 40

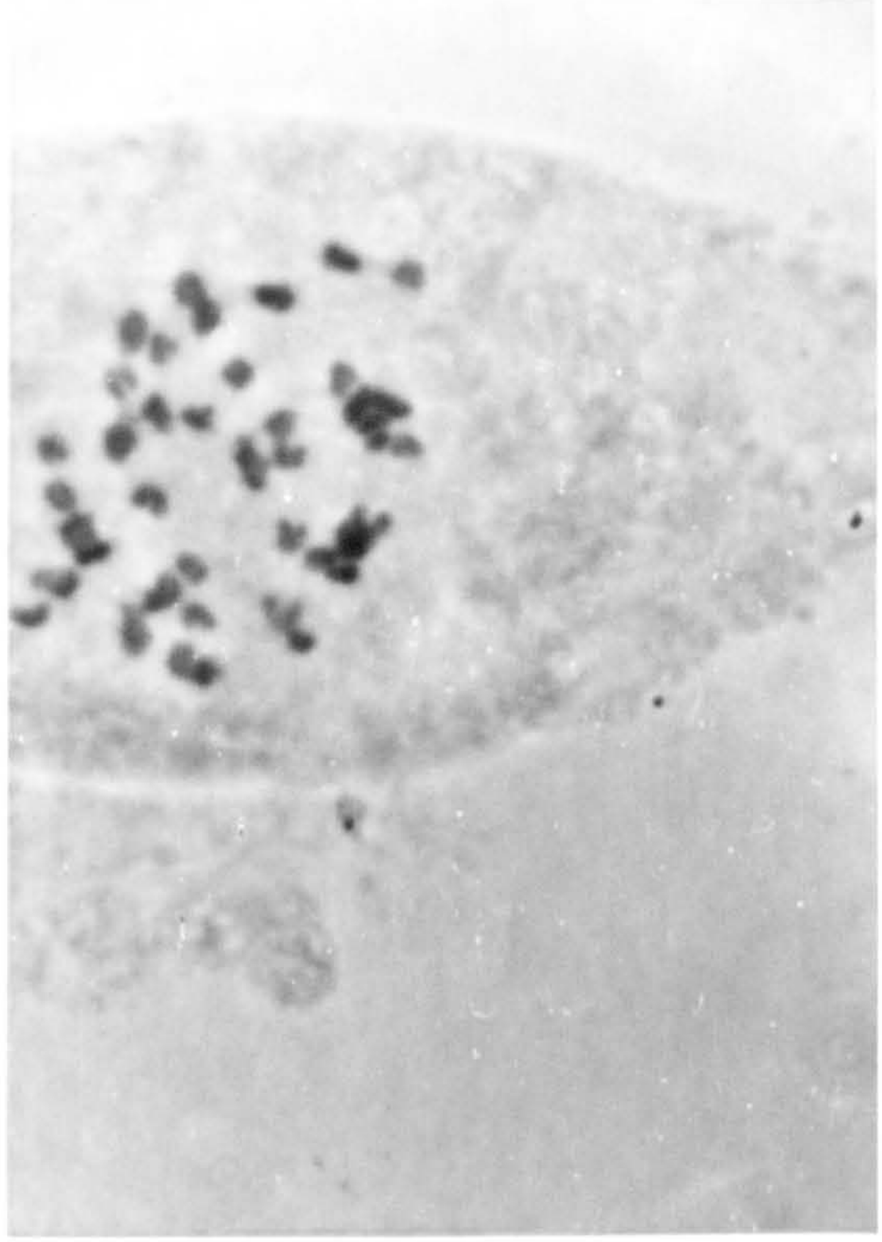


Figure 100 :
Olgasis gauntlettii
2n = 42

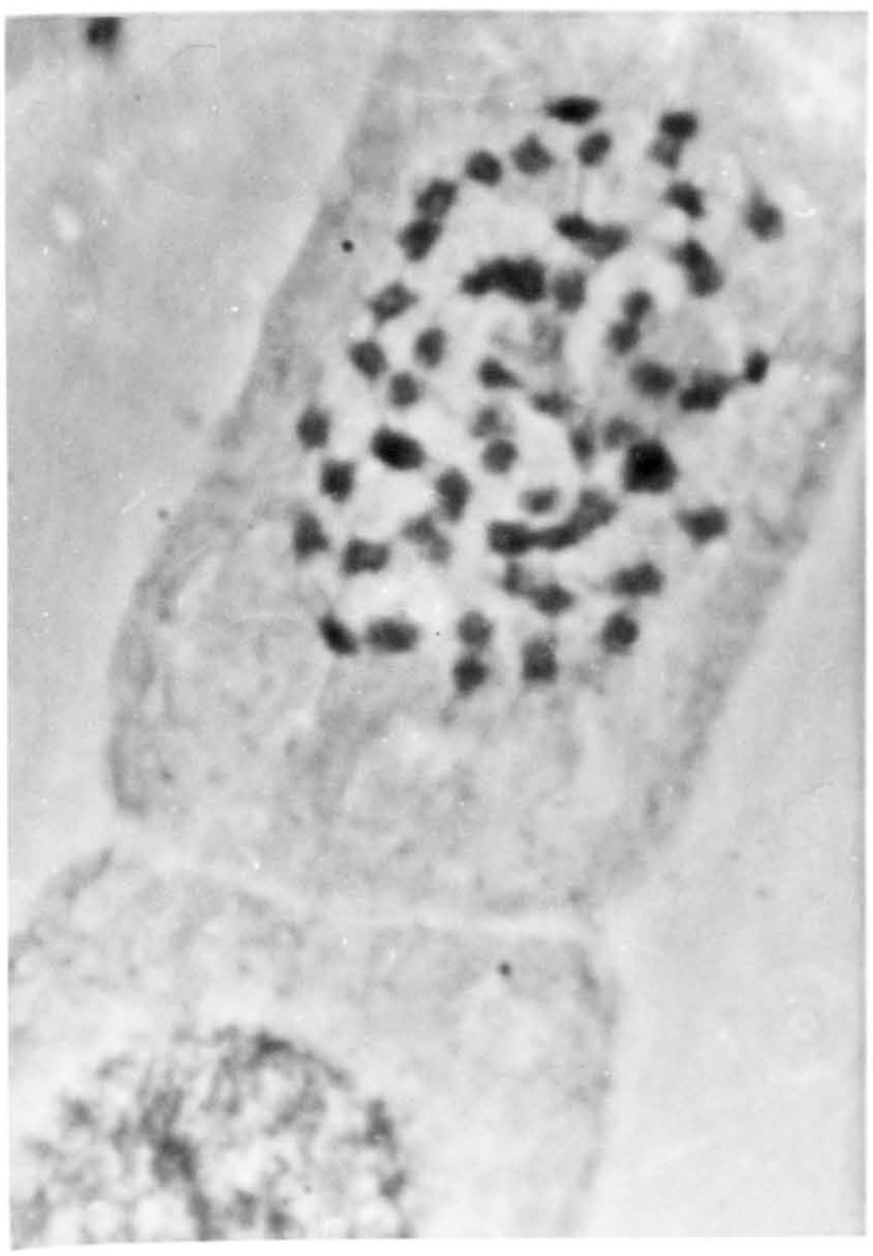


Figure 101 :
Olgasis triquetra
2n = 42

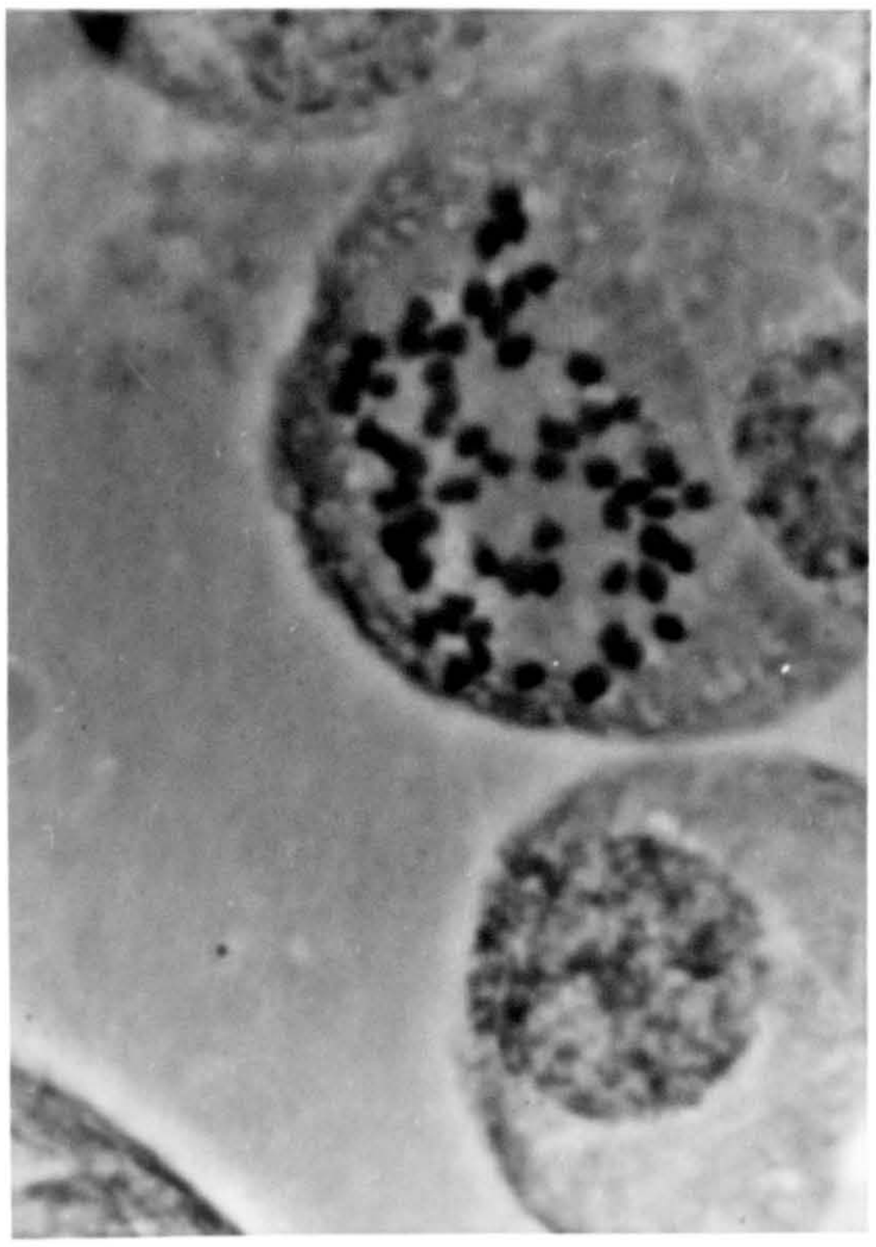


Figure 102 :
Tolumnia bahamensis
2n = ca. 84

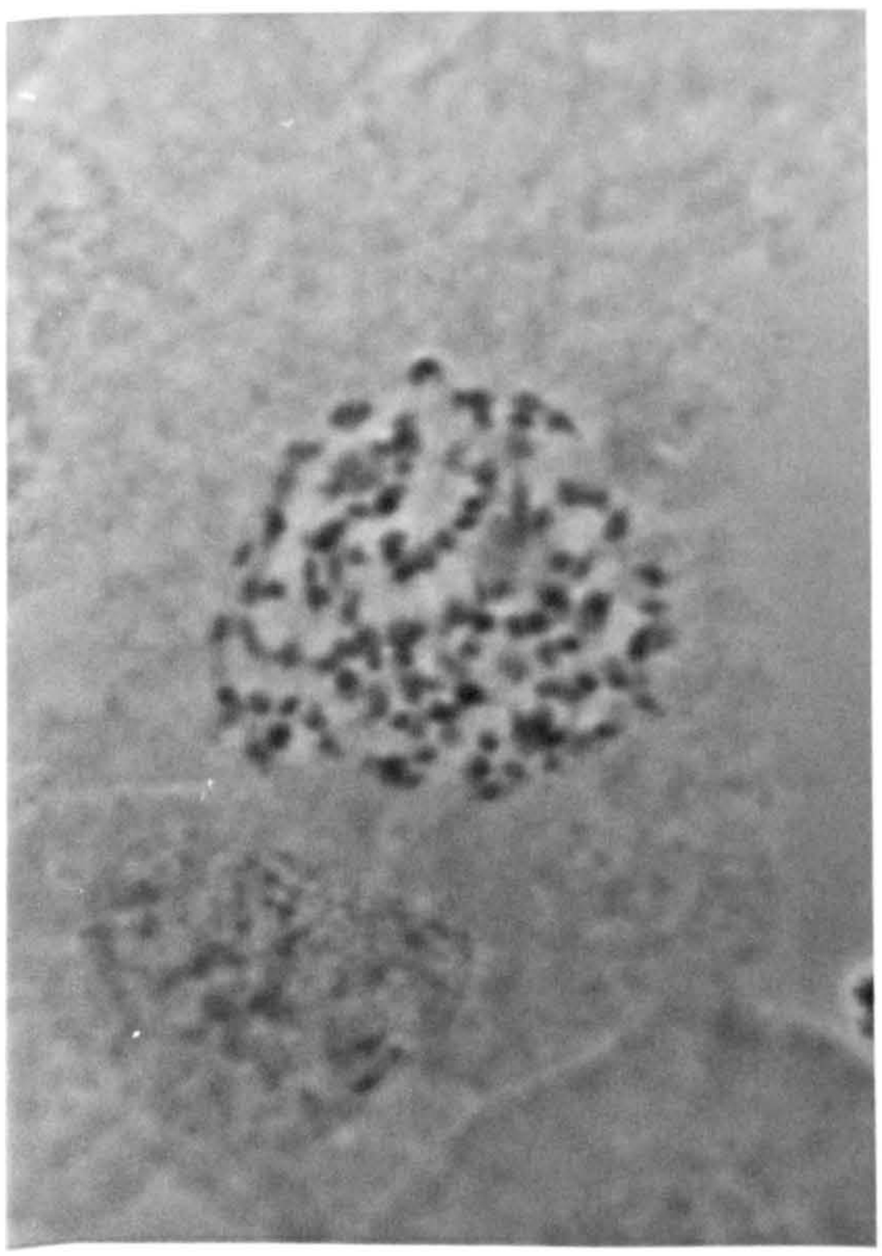


Figure 103 :
Tolumnia calochila
2n = ca. 42

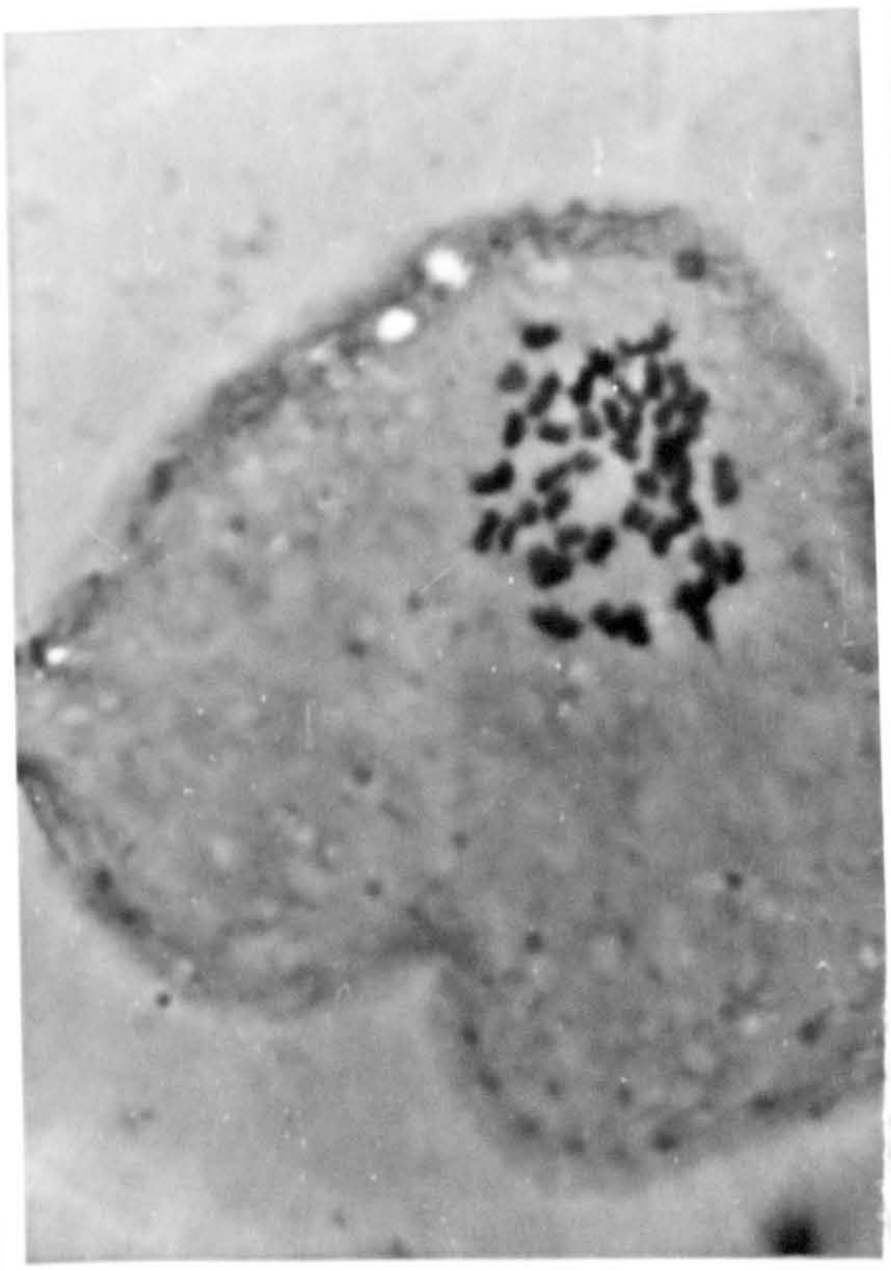


Figure 104 :
Tolumnia compressicaulis
2n = ca. 42

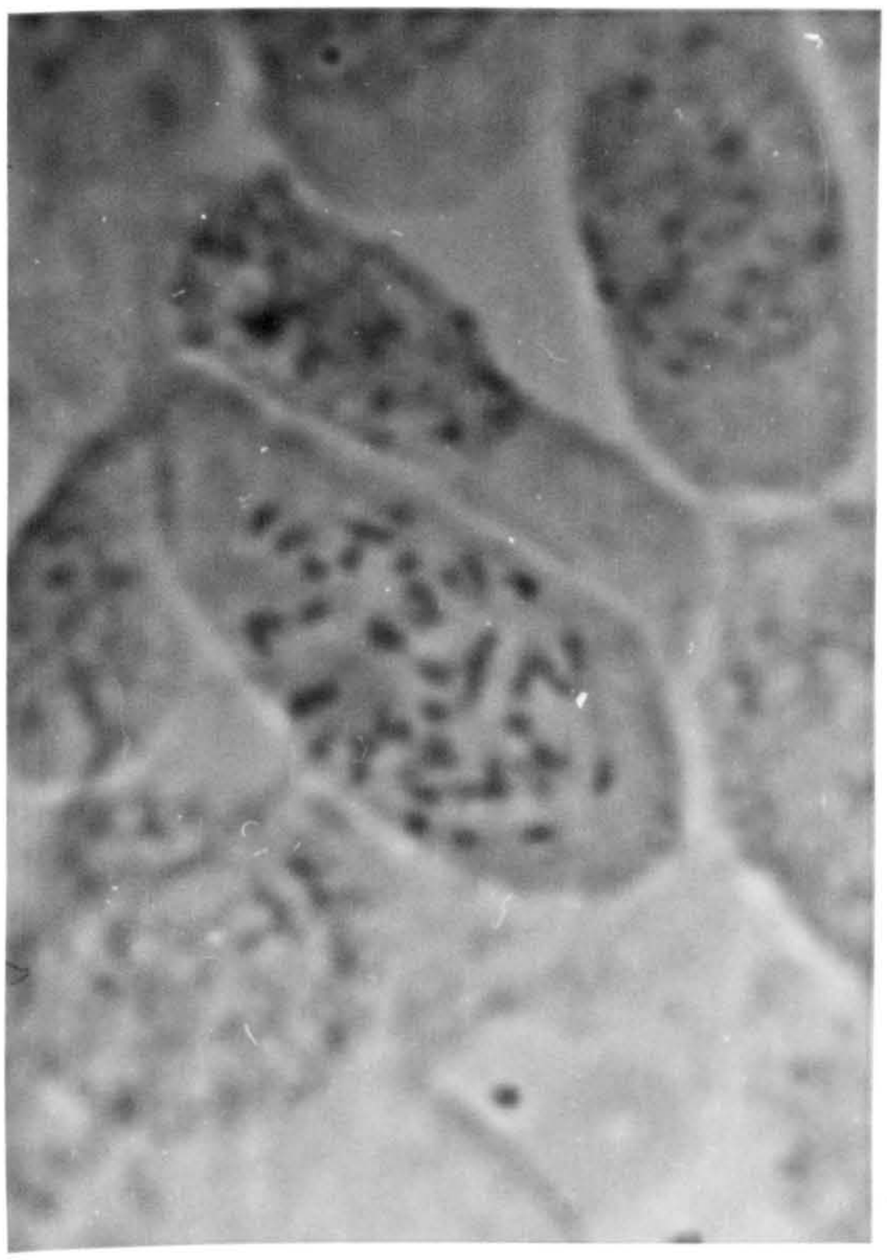


Figure 105 :
Tolumnia guianensis
2n = 40

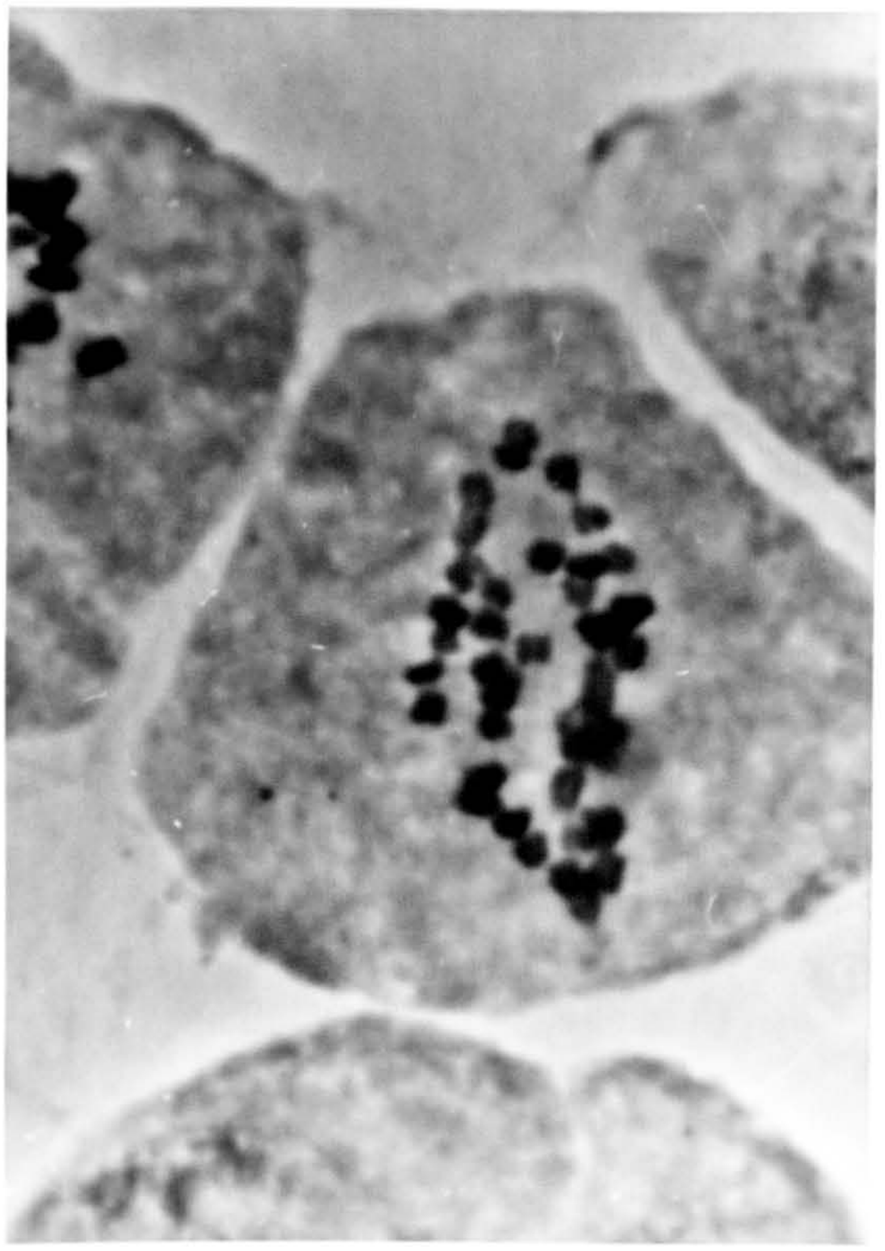


Figure 106 :
Tolumnia guianensis
var. alborubrum
2n = 40

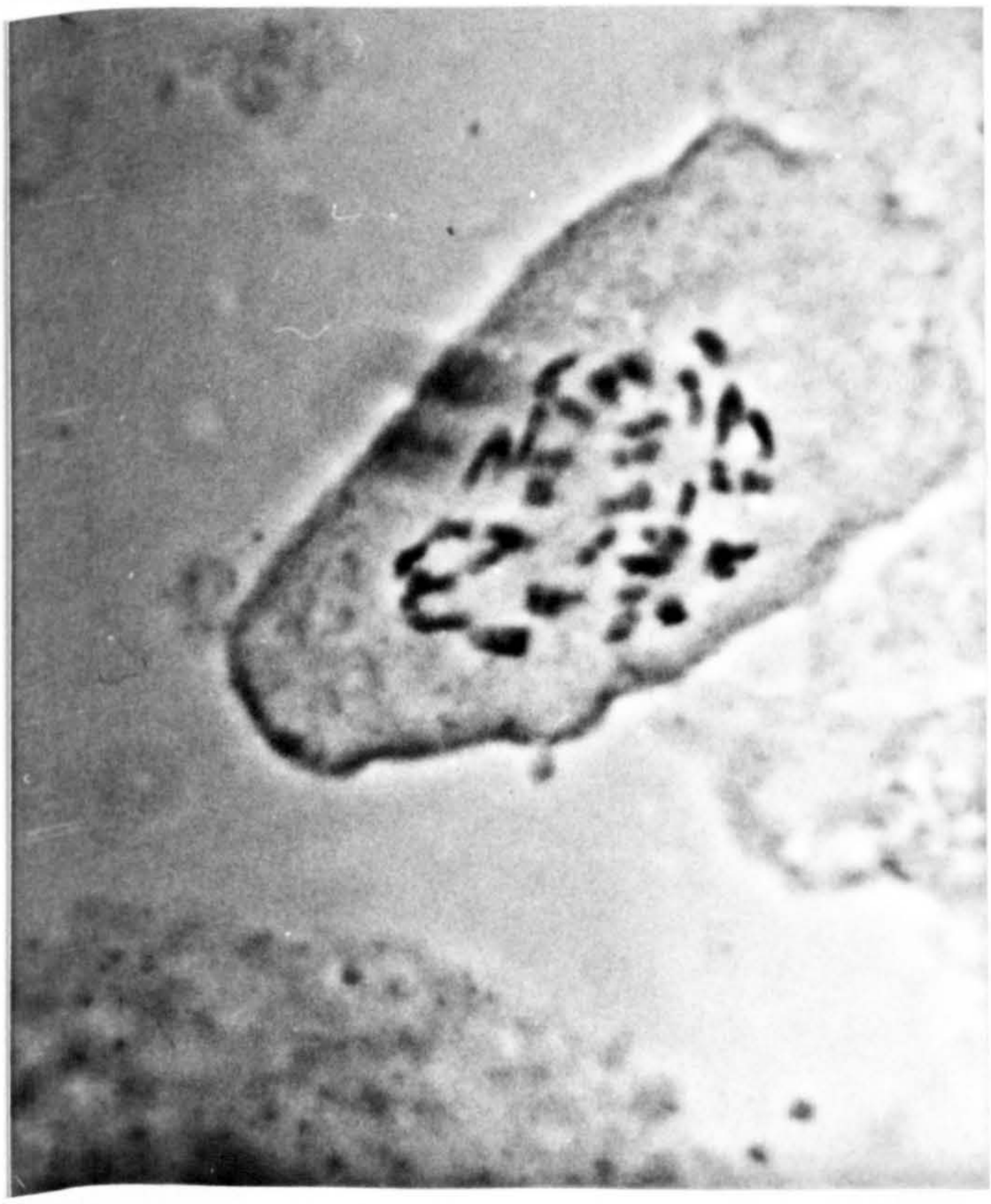


Figure 107 :
Tolumnia haitiensis
2n = 40

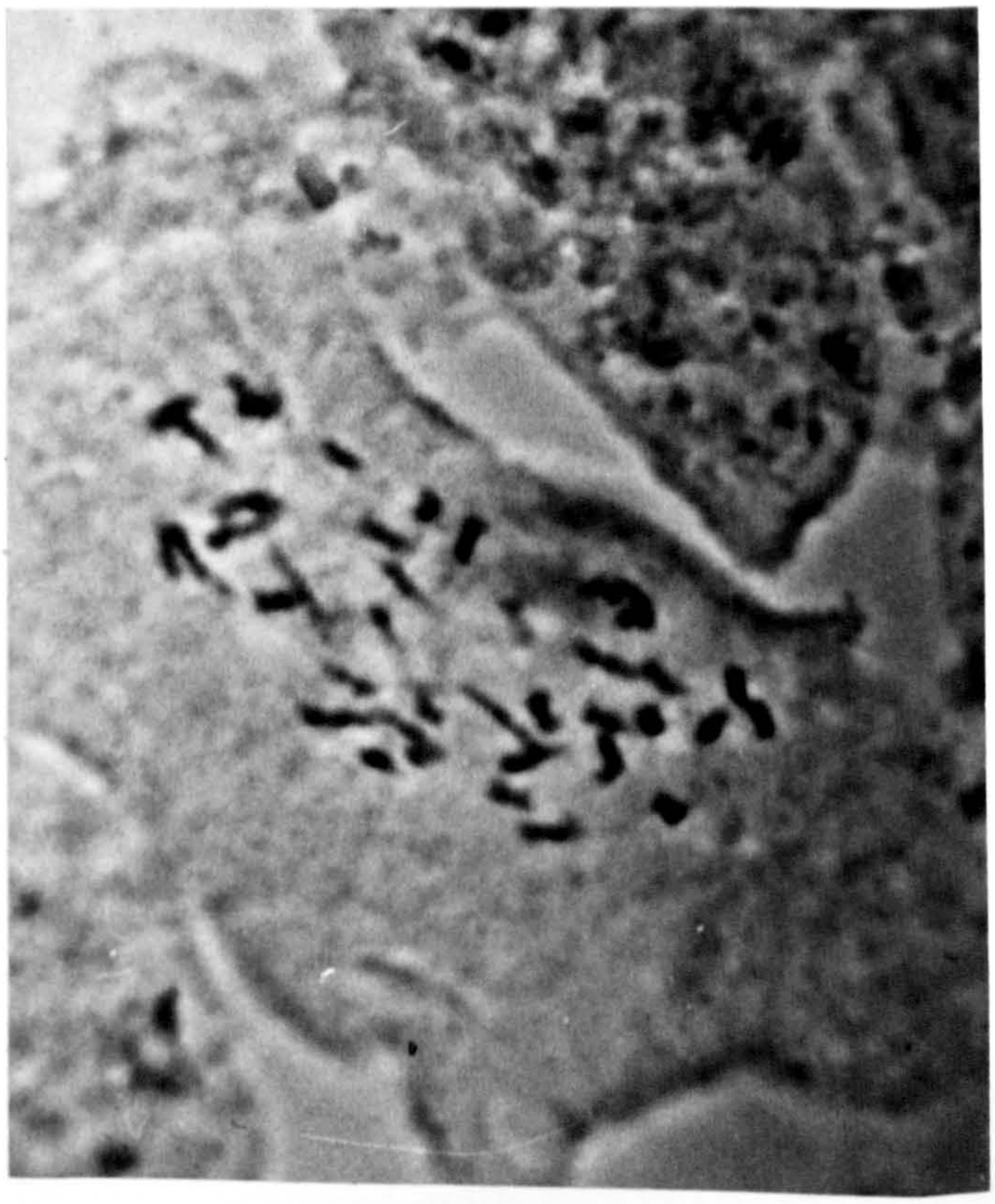


Figure 108 :
Tolumnia hawkesiana
2n = 126

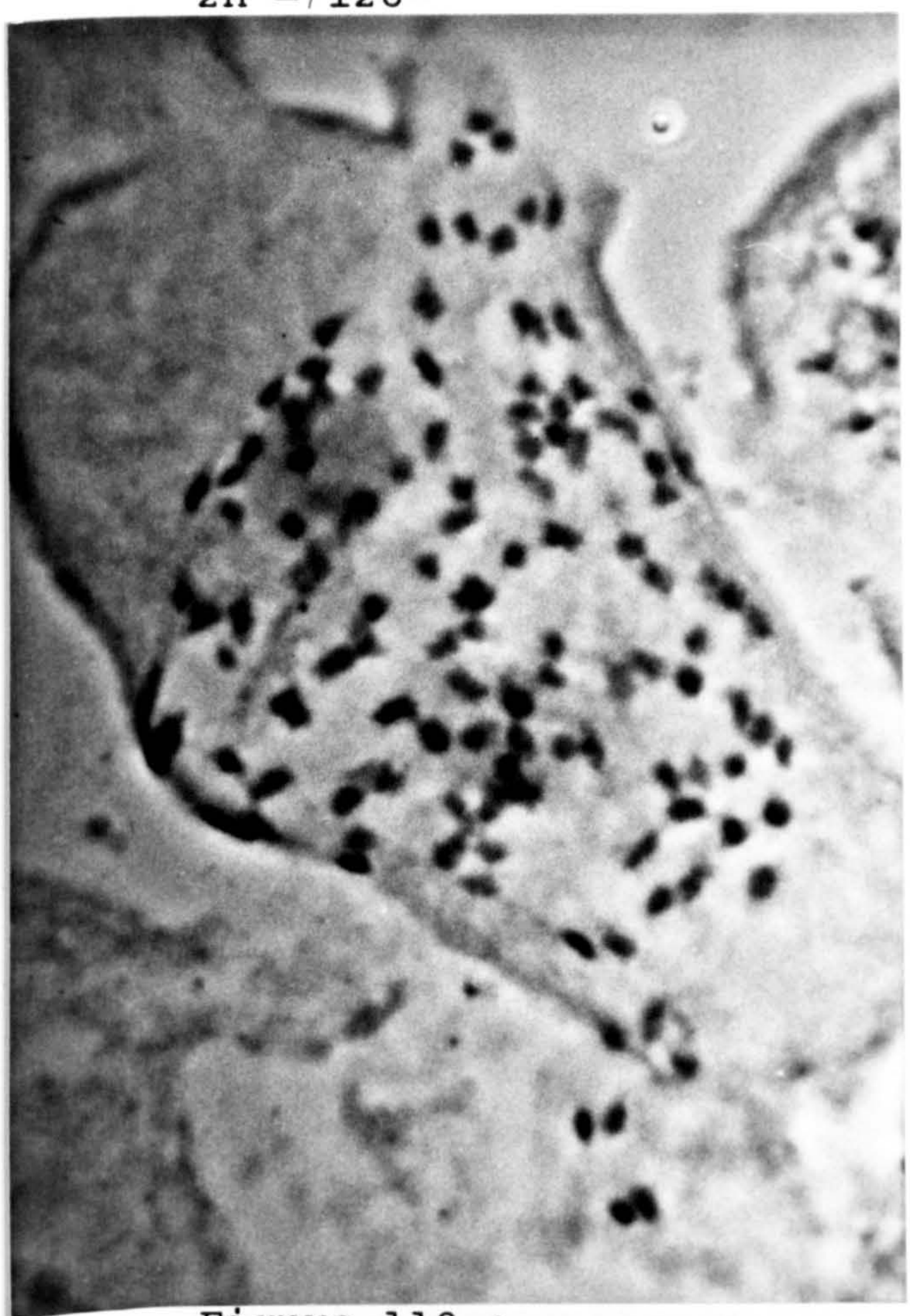


Figure 109 :
Tolumnia lemoniana
ssp. guibertiana
2n = 42

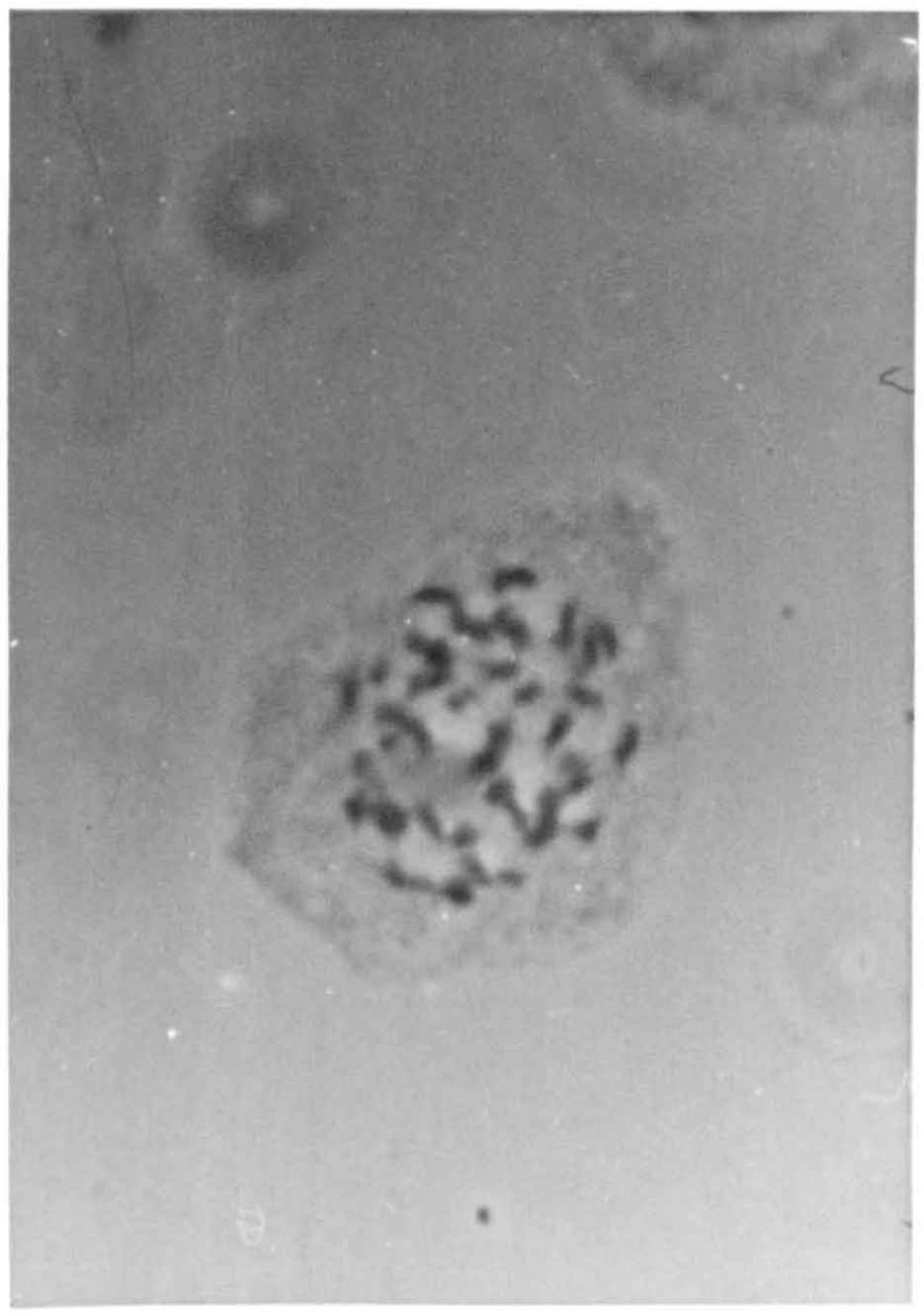


Figure 110 :
Tolumnia lucayana
2n = 40

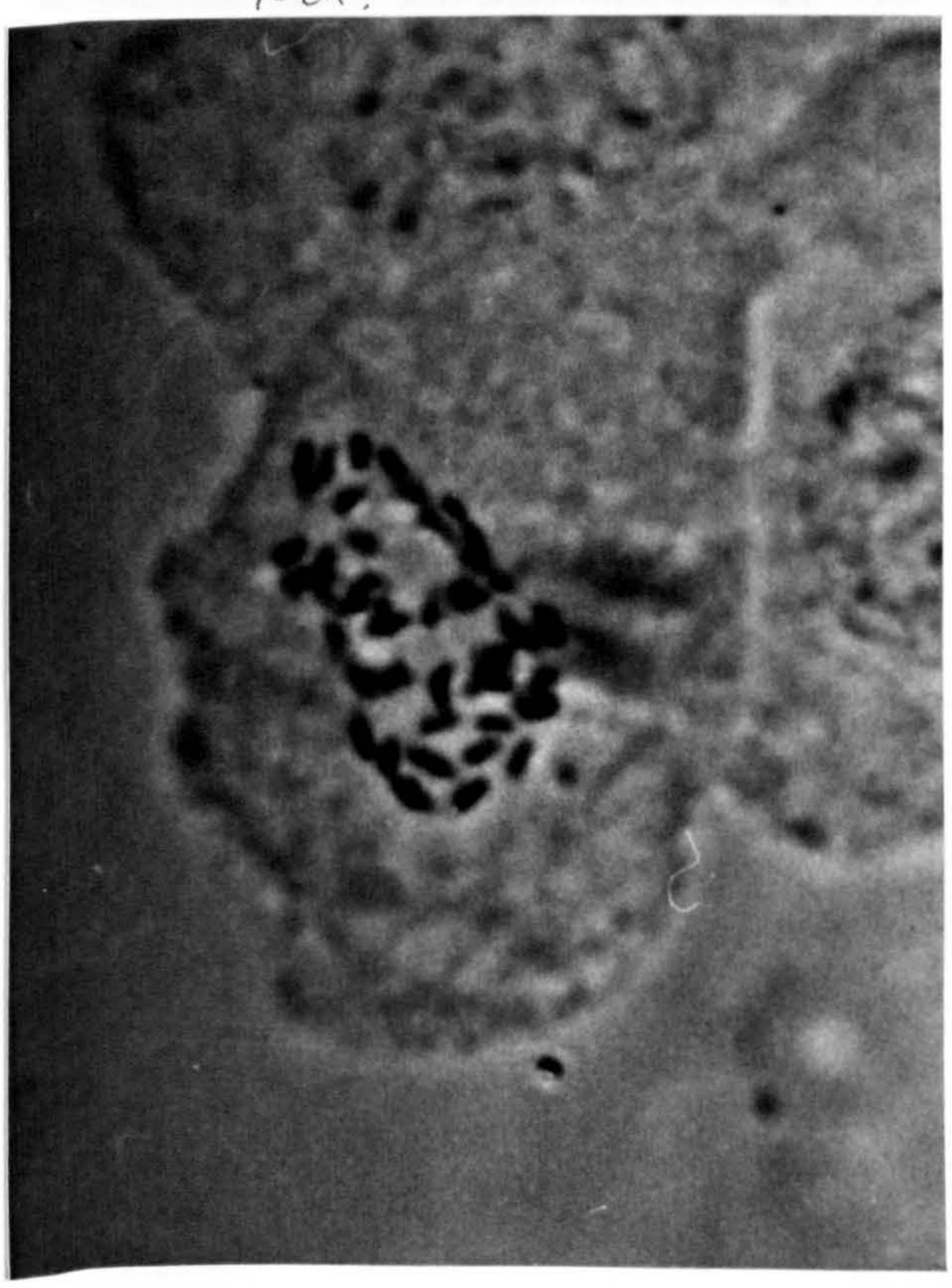


Figure 111 :
Tolumnia x osmentii
2n = 40

Figure 112 :
Tolumnia prionochila
2n = ca. 126

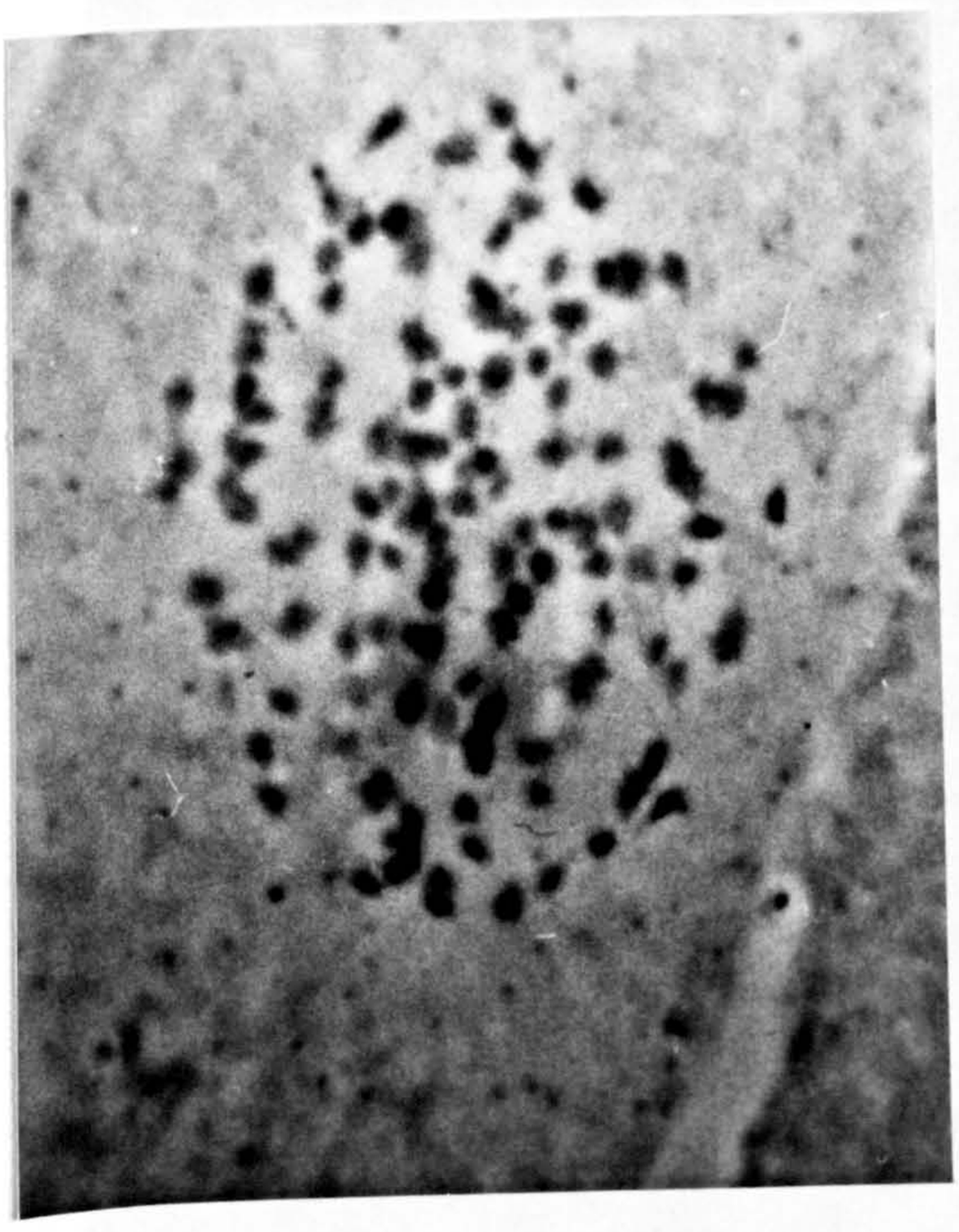


Figure 113 :
Tolumnia pulchella
2n = 42

Figure 114 :
Tolumnia quadrilobia
2n = 40

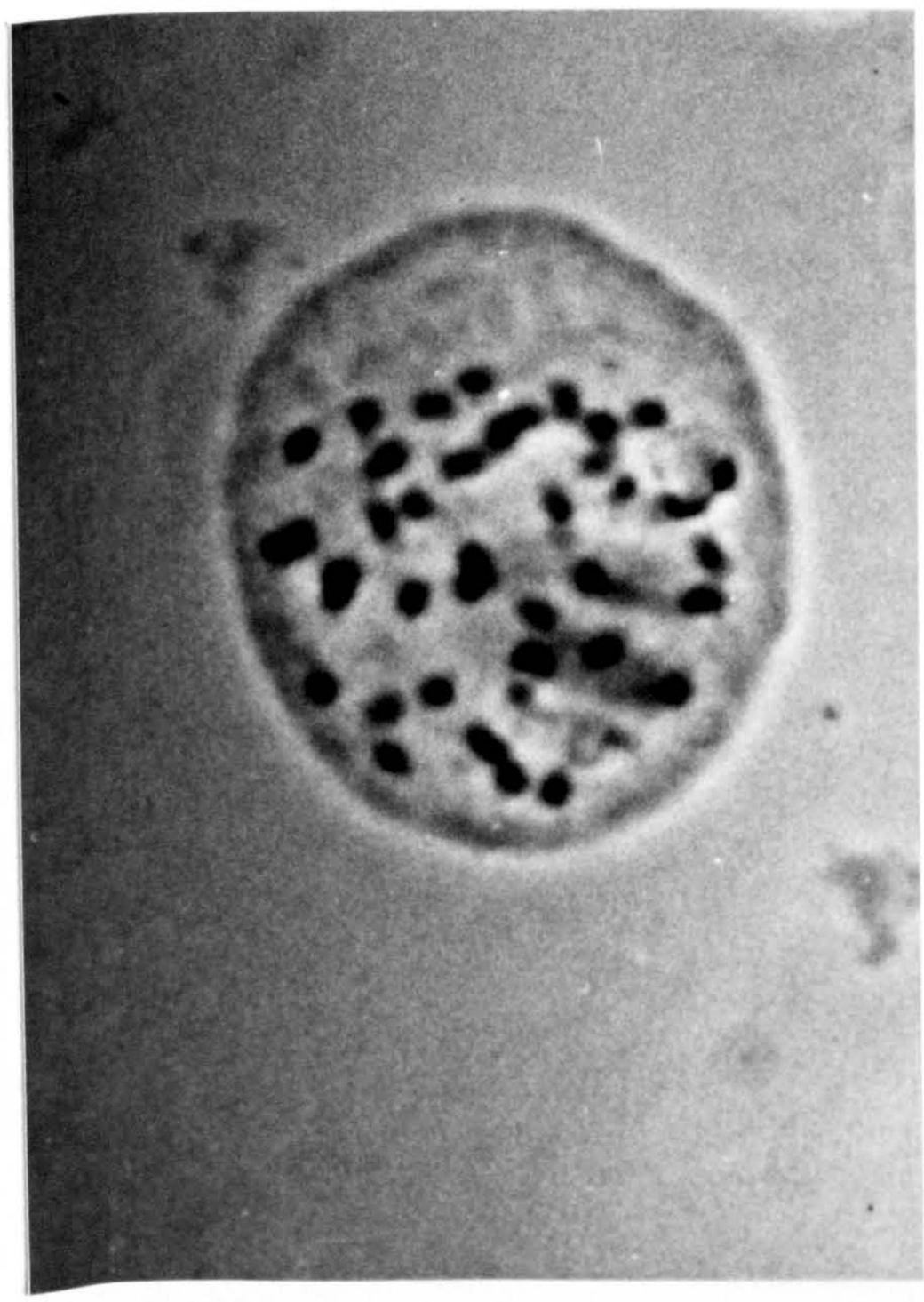


Figure 115 :
Tolumnia sasseri
2n = ca. 84

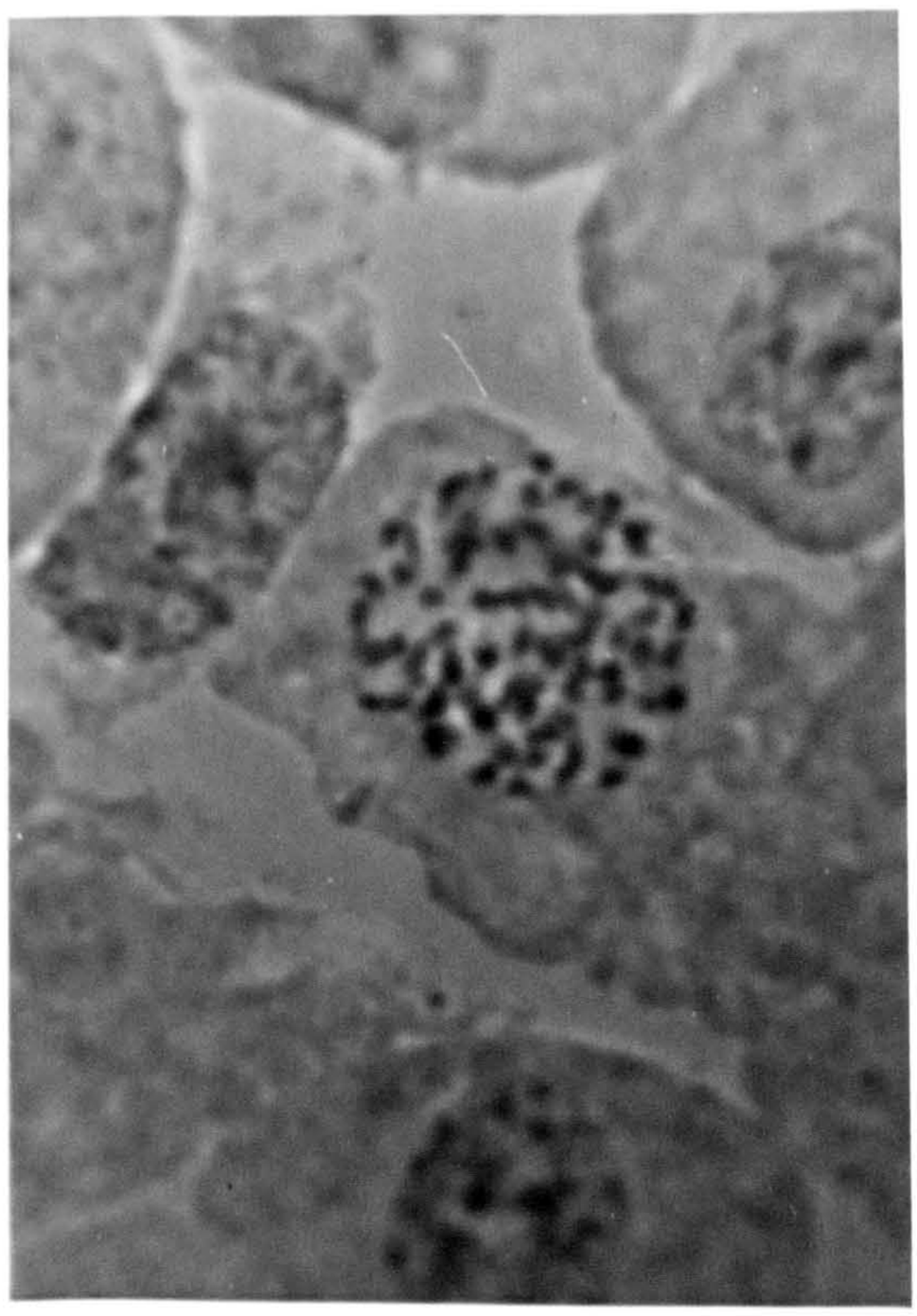


Figure 116 :
Tolumnia scandens
2n = ± 84 ca.

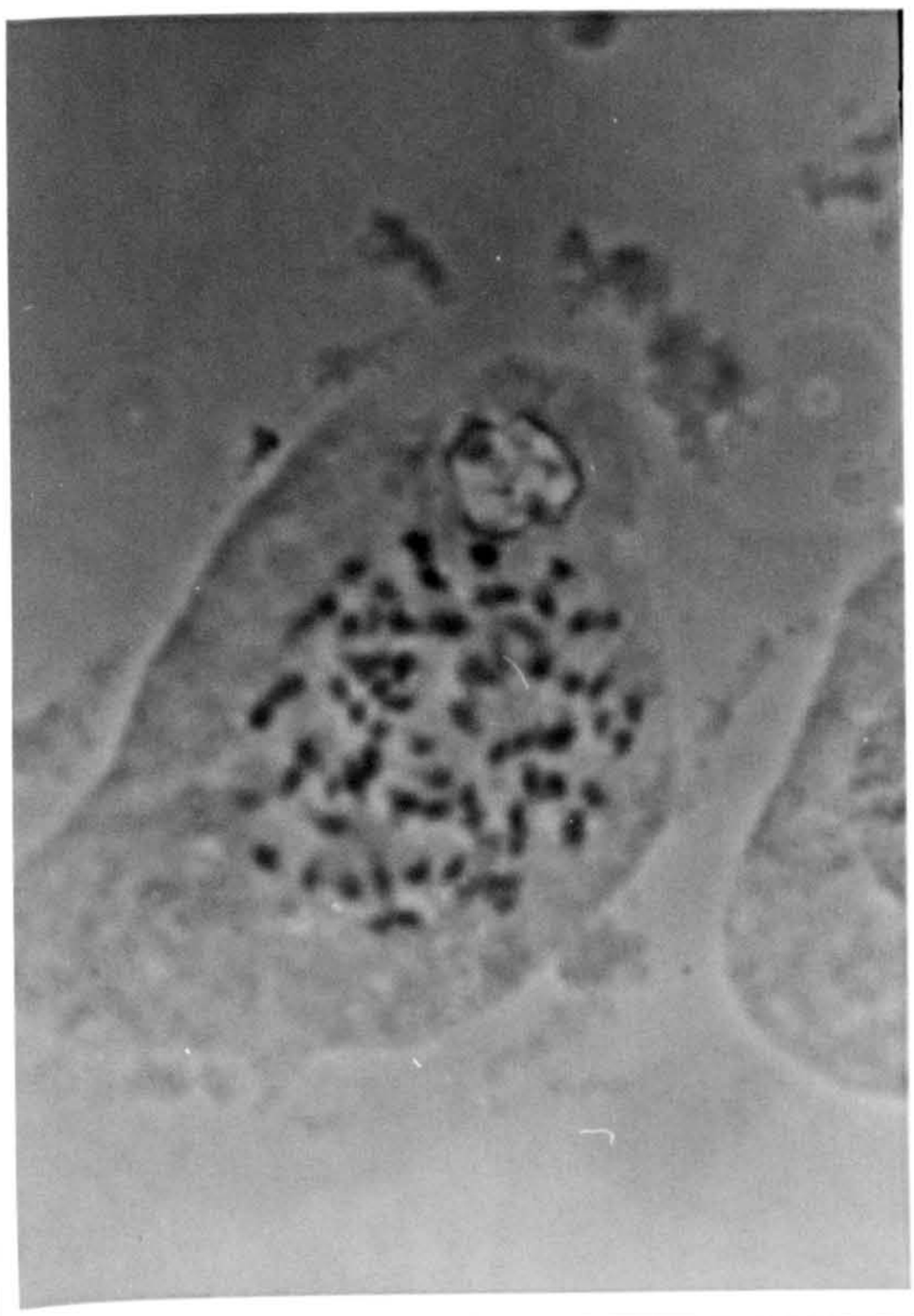


Figure 117 :
Tolumnia sylvestris
2n = ± 84 ca.

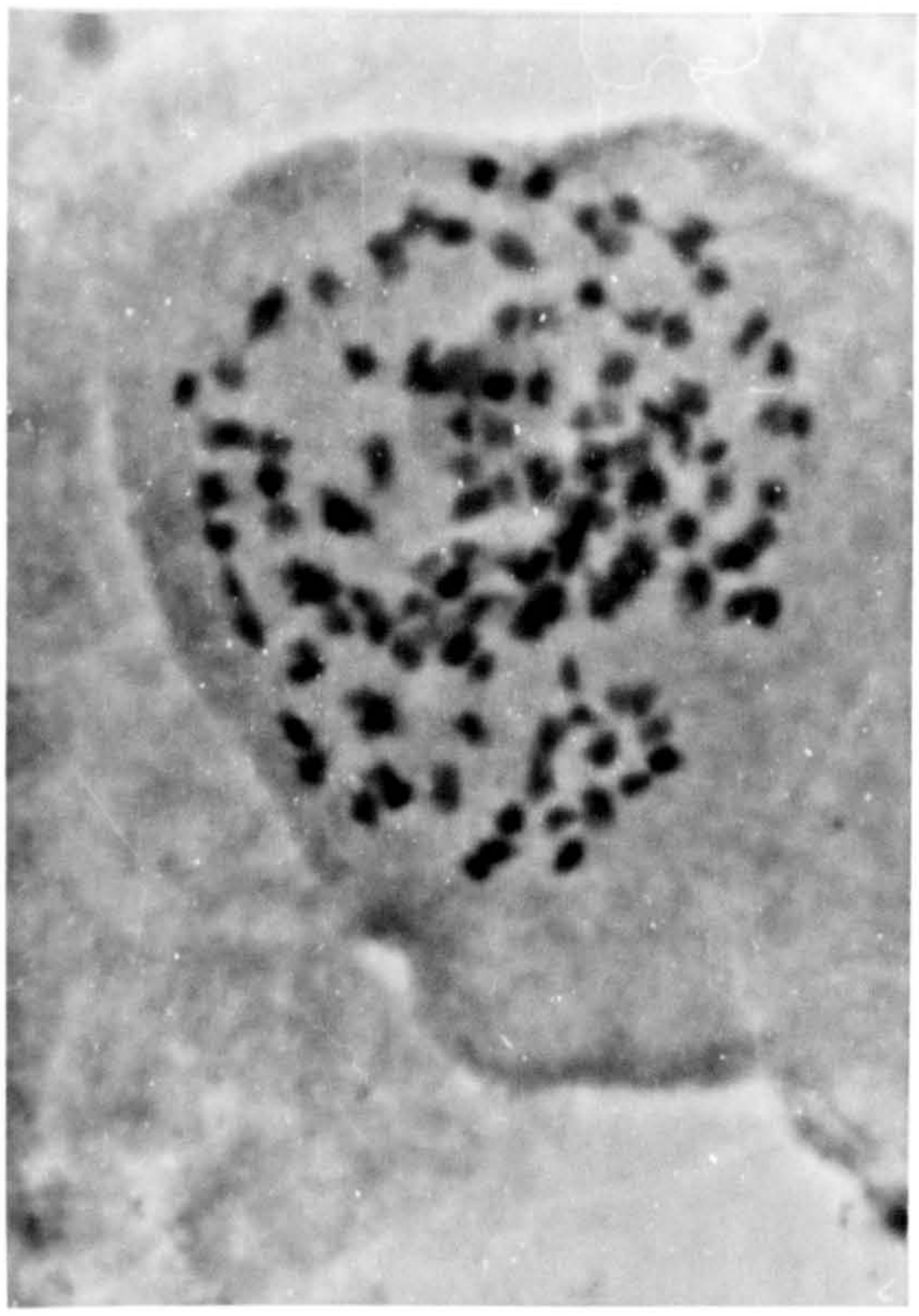


Figure 118 :
Tolumnia tetrapetala
2n = 42

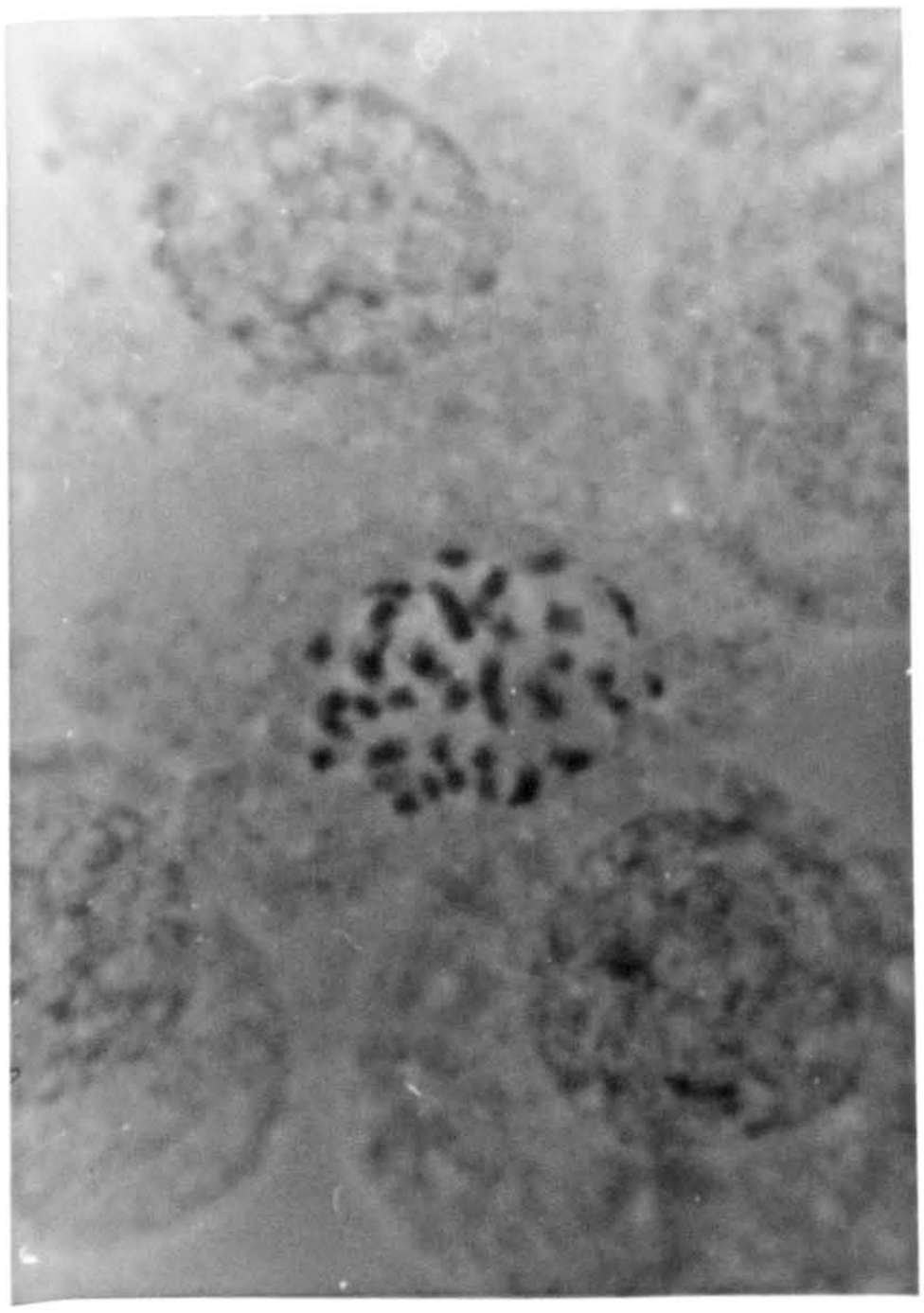


Figure 119 :
Tolumnia tuerckheimii
2n = 42

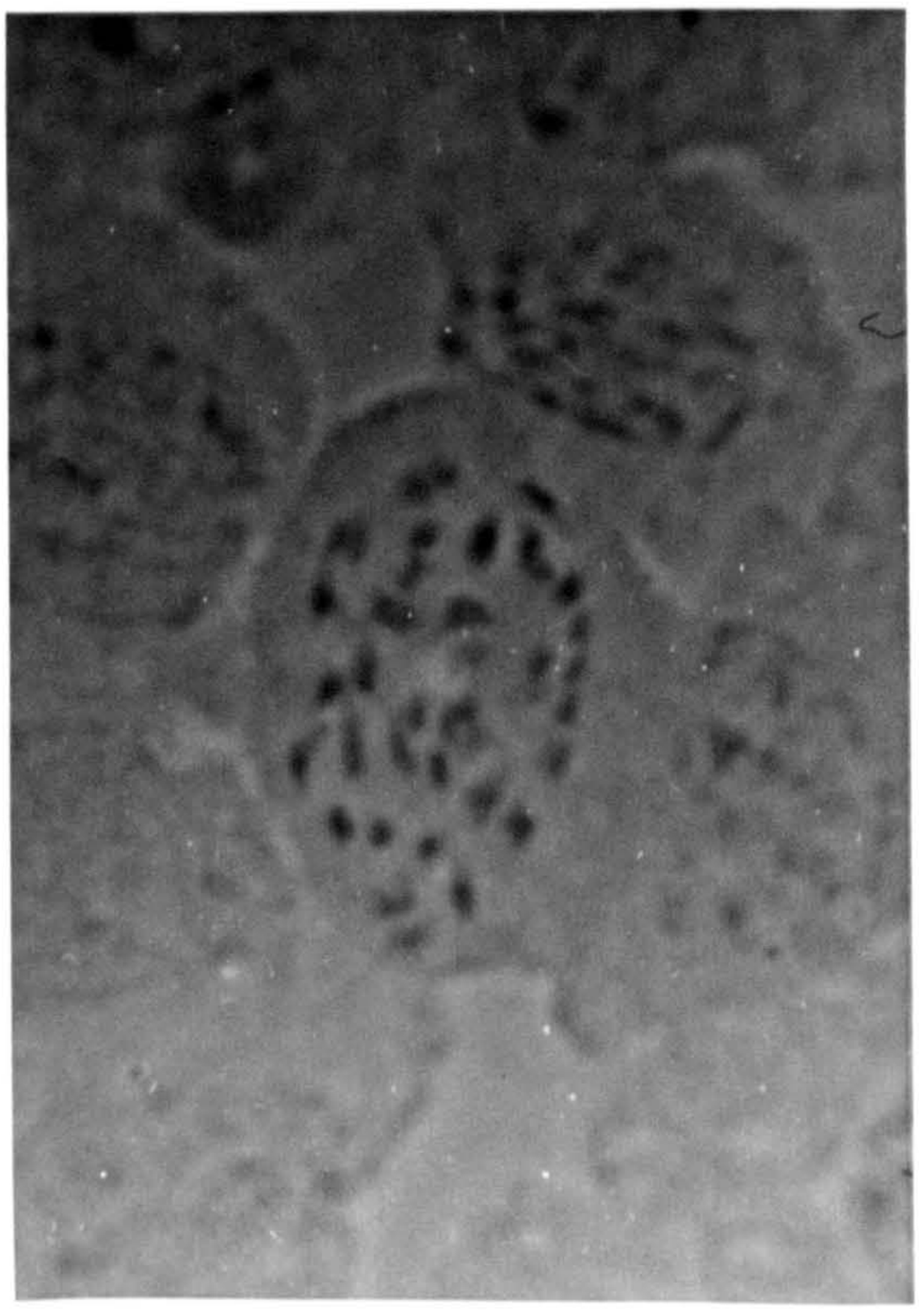


Figure 120 :
Tolumnia urophylla
2n = ca. 84

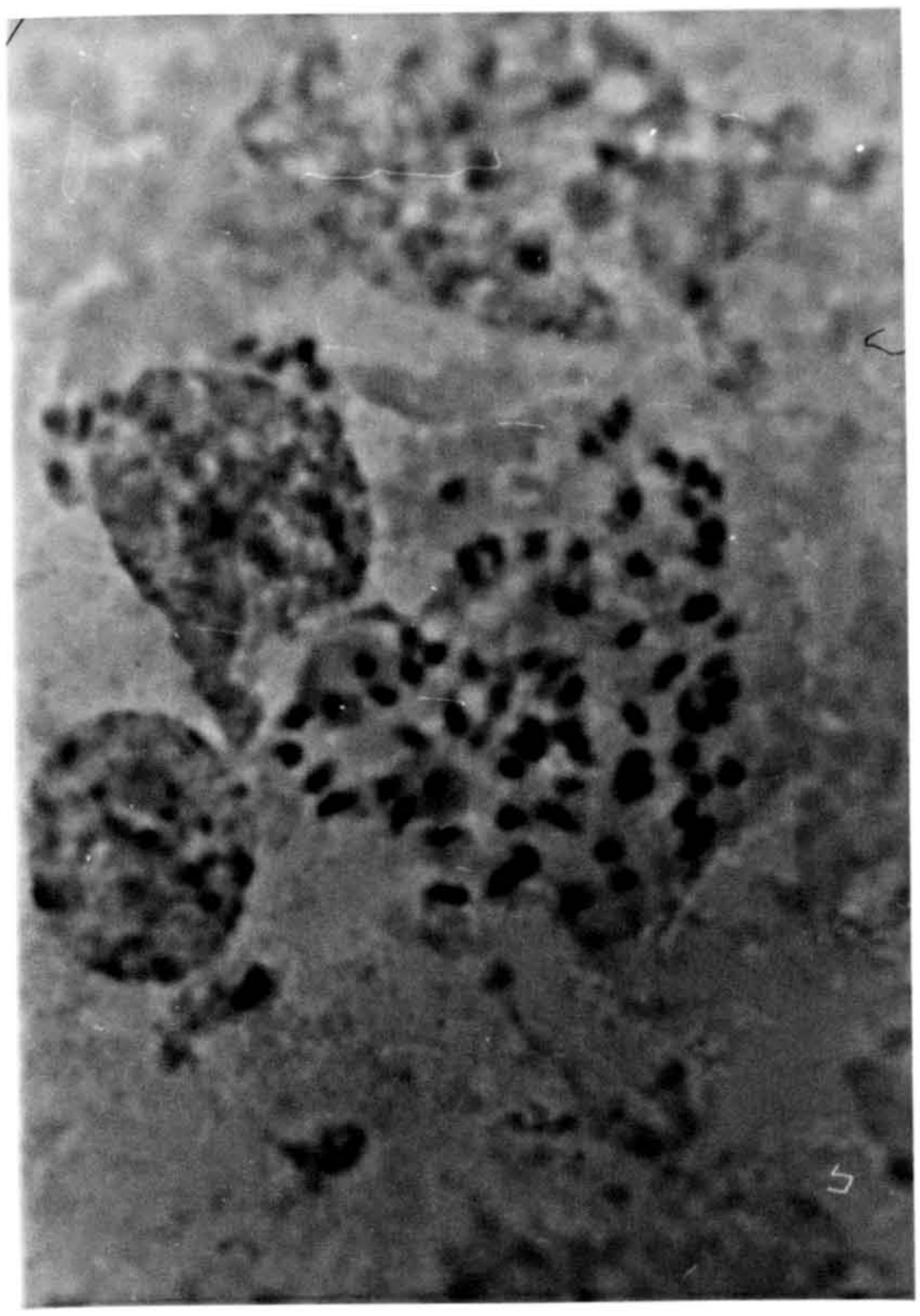


Figure 121 :
Tolumnia variegata
2n = 42

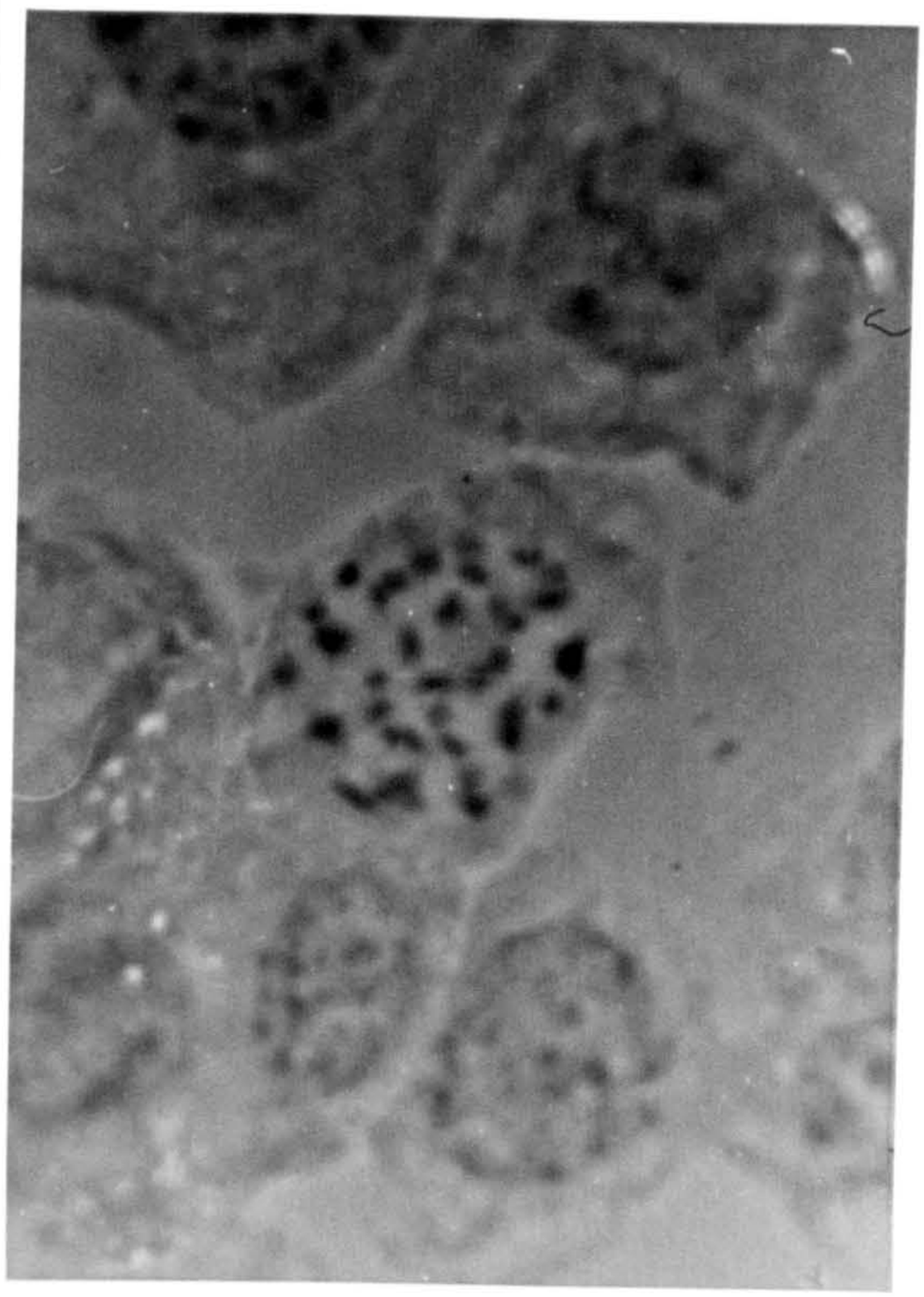


Figure 122 :
Tolumnia velutina
2n = ca. 84

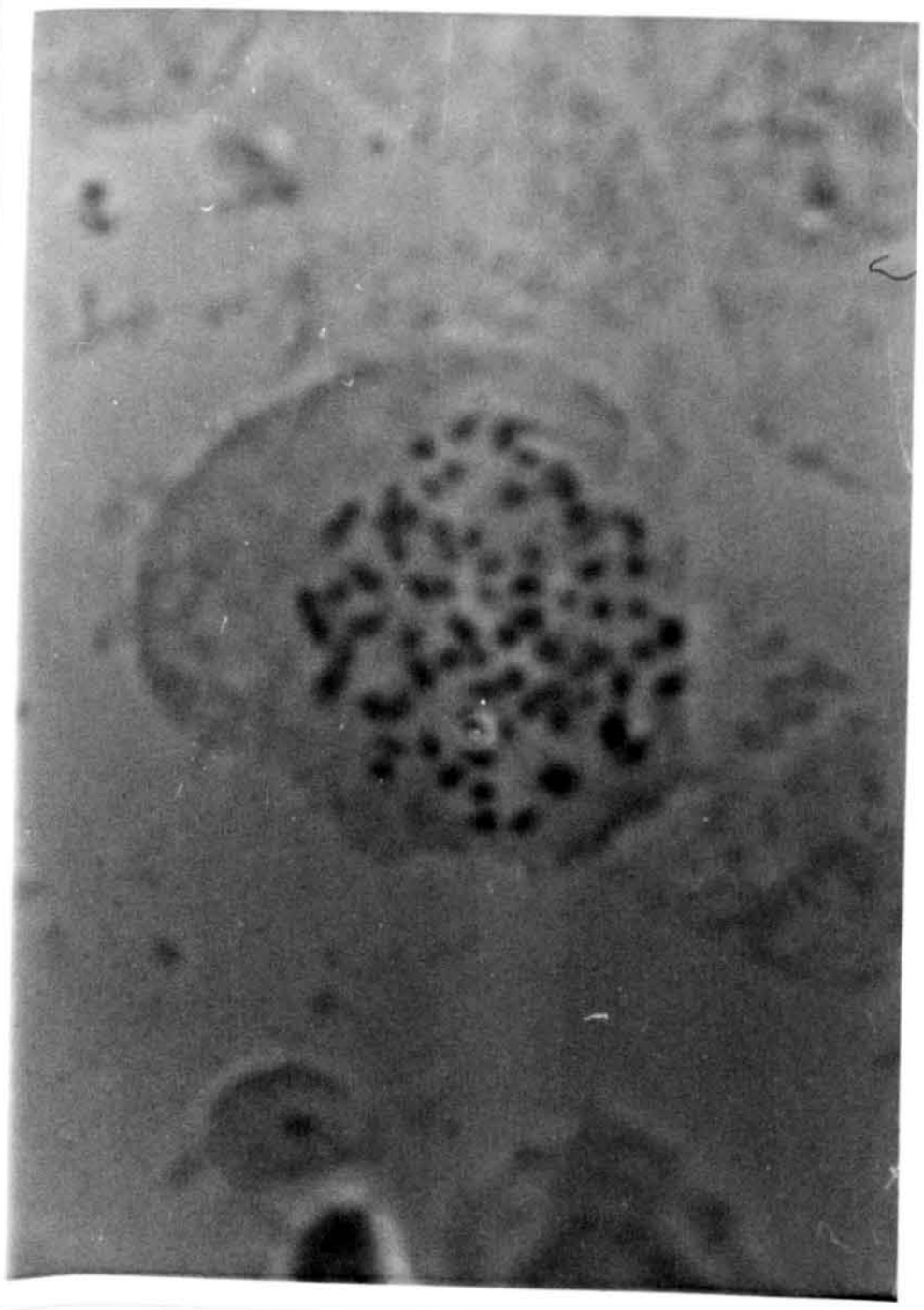


Table 19 : Chromosome Counts (2N) compared to those reported in the literature

	Dodsen 1958	Kugust 1966	Sinoto 1962	Sinoto 1969	Charanasri 1973	Charanasri 1975	Phang 1979	Braem 1986	Accession code of plants examined (see: 4.3.1.2)
B. arizajuliana	–	–	–	–	–	–	–	42	01,02
H. henekenii	–	–	40	40	40	40	–	40	06,07
O. gauntlettii	–	–	–	–	–	–	–	42	10
O. triquetra	42	–	42	42	42	–	42	42	13,15
T. bahamensis	–	–	84	–	84	84	–	c. 84	17,18
T. calochila	–	–	–	–	–	42	–	c. 42	40,42
T. compressicaulis	–	–	–	–	–	–	–	c. 42	44
T. guianensis	–	40	40	40	40	40	–	40	46,49,51
T. guianensis var. alborubrum	–	–	–	–	–	–	–	40	47,50
T. haitiensis	–	–	–	–	–	–	–	40	55,56
T. hawkesiana	–	–	133	133	–	–	–	c. 126	19,20,21
T. leiboldii	42	40	42	42	–	42	–	–	–
T. lemoniana ssp. lemoniana	–	–	–	–	–	42	–	–	–
T. lemoniana ssp. guibertiana	–	–	–	–	–	–	–	c. 42	59
T. lucayana	–	40	40	–	40	40	–	c. 40	60,61
T. x osmentii	–	–	–	–	–	–	–	40	79
T. prionochila	–	–	–	–	–	–	–	c. 126	63,64
T. pulchella	42	42	42	42	42	–	–	42	66,67,68
T. quadrilobia	–	–	–	–	–	40	–	40	71
T. sasseri	–	–	–	–	–	–	–	c. 84	22
T. scandens	–	–	84	84	–	84	–	c. 84	23,24,25
T. sylvestris	–	–	84	84	–	126	–	c. 84	26
T. tetrapetala	42	–	–	–	–	–	–	42	72,74,75
T. tuerckheimii	–	–	–	–	–	–	–	42	76,77
T. urophylla	–	–	84	84	–	84	–	c. 84	28,29
T. usneoides	–	–	–	–	–	–	–	–	–
T. variegata	42	–	40	40	42	42	42	42	32,33,34,35,36,37
T. velutina	–	–	–	–	84	–	–	c. 84	38,39

4. 5. 2. 3. DISCUSSION

For nine taxa of the "Variegata" (Braasiella arizajuliana, Olgasis gauntlettii, Tolumnia compressicaulis, Tolumnia guianensis var. alborubrum, Tolumnia haitiensis, Tolumnia x osmentii, Tolumnia prionochila, Tolumnia sasseri and Tolumnia tuerckheimii) the 2n numbers are reported for the first time. The counts indicate their affinity to other species within the group of plants under examination.

The counts of Hispaniella henekenii, Olgasis triquetra, Tolumnia bahamensis, Tolumnia calochila, Tolumnia guianensis, Tolumnia lemoniana, Tolumnia lucayana, Tolumnia pulchella, Tolumnia quadrilobia, Tolumnia scandens, Tolumnia tetrapetala, and Tolumnia urophylla confirm the data as found in the stated literature.

For Tolumnia hawkesianum I have made counts of 3 different plants. All counts yielded 2n =ca. 126, not 2n = 133 as previously reported on two occasions by Sinoto (1962,1969).

For Tolumnia sylvestris I obtained a count of 2n =ca. 84, confirming the data of Sinoto (1962,1969) but not of Charanasri et al (1975)

For Tolumnia variegata, I made counts on 6 different plants. All counts amounted to 2n= 42 confirming all authors except for Sinoto (1962,1969).

Very little can be said about the chromosome morphology as the cells and the chromosomes are extremely small and difficult to count and examine. The preparations obtained do not allow to comment on variation in size and centromere position.

The results of the cytogenetic study is scored for computer analysis as follows:

Count:	Score:
2n = 40	00
2n = 42	01
2n = 84	11
2n = 126/133	10

4. 6. LEAF FLAVONOID FINGERPRINTING

4. 6. 1. INTRODUCTION AND REVIEW OF PERTINENT LITERATURE

The flavonoid compounds in leaf material have been examined as a taxonomic marker on the level of family and subfamily on many occasions, for instance in the Ericaceae (Harborne & Williams 1973) and in the Oleaceae (Harborne and Green 1980). Studies on the generic level were performed with Cannabis L. (Clark & Bohm 1979).

As far as the Orchidaceae are concerned, chemical investigations have concentrated largely on alkaloid constituents (Luning 1974) and the identification and inheritance of flower pigments in species of ornamental value (Arditti & Fish 1977). Incorporated in a survey of the leaf flavonoids in the families of the monocotyledons, the orchids were examined as well (Williams 1979).

Williams found that for 53 % of the species sampled, orchids were found to contain flavone C-glycosides and that for 37 % of all orchid species examined flavonols were detected. Within the Oncidiinae, only 5 genera with a total of 6 species were examined by Williams. Five of the sampled species proved to contain 6-hydroxy-flavones, rare components, only discovered in six of the 142 orchids surveyed in the study.

It was not my intention to perform a similar detailed study with the identification of each flavonoid compound, but to examine whether "fingerprinting" of leaf flavonoids can be used as a taxonomic marker at the generic and specific levels within the Orchidaceae. For that purpose, I examined leaf ma-

terial of 28 taxa of the "Variegata", a total of 21 taxa of various sections of the genus Oncidium and of 8 taxa of related genera within the Oncidiinae.

4. 6. 2. TWO-DIMENSIONAL PAPER CHROMATOGRAPHY OF LEAF FLAVONOIDS

4. 6. 2. 1. MATERIALS AND METHODS

For each plant examined, about 2 grams of fresh leaf material [1] was chopped up into small pieces of about 1 mm in thickness and length. The sample was shaken with 200 ml of 70% methanol (CH_3OH) in a conical flask for at least 24 hours.

The alcoholic extract was removed by decanting and reduced in a rotating condenser to a sample of about 0.5 ml.
This concentrated extract was transferred to a small vial and the condensing flask was rinsed twice with a small volume of 100% methanol (CH_3OH). These rinses were added to the sample.

200 microliters of each sample were applied to a sheet of Whatman chromatographic paper grade 3 M using a 20 microliter pipette (Drummond Scientific Company). The applied sample was allowed to dry out between each application.

Leaf flavonoids were separated in two dimensional paper chromatography at room temperature.

For the first dimension, which was generally run overnight, a solvent composed of equal volumes of N-butanol and 27% acetic acid was used. The solvent was mixed shortly before usage.
After completion of the first dimension, the chromatograms were allowed to dry completely.

---

(1) For Tolumnia usneoides only herbarium material was available.

When dry, the chromatogram was examined under UV light (360 nm) and the different spots were marked with a pencil. After this, the chromatogram was replaced in the chromatography tank for second dimensional separation of the flavonoids with a solvent consisting of 15% acetic acid. This separation, again, was performed at room temperature.

After completion, the chromatogram was again allowed to dry out completely and the spots were subsequently marked under UV-light (360 nm). The chromatogram was treated with NH_3-vapour to differentiate the 3'-OH-flavonoids from the 5'-OH flavonoids (Mabry, Markham & Thomas 1970).

4. 6. 2. 2. RESULTS

A total of 42 different spots were recognized and marked when present for each taxa examined. Figure 123 shows the position of each of the 42 recognized spots. Within the "Variegata" none of the flavonoid spots were visible under normal light.

Figure 123 : Location of spots as recognized under UV-light (360 nm). (Representation in exact scale).

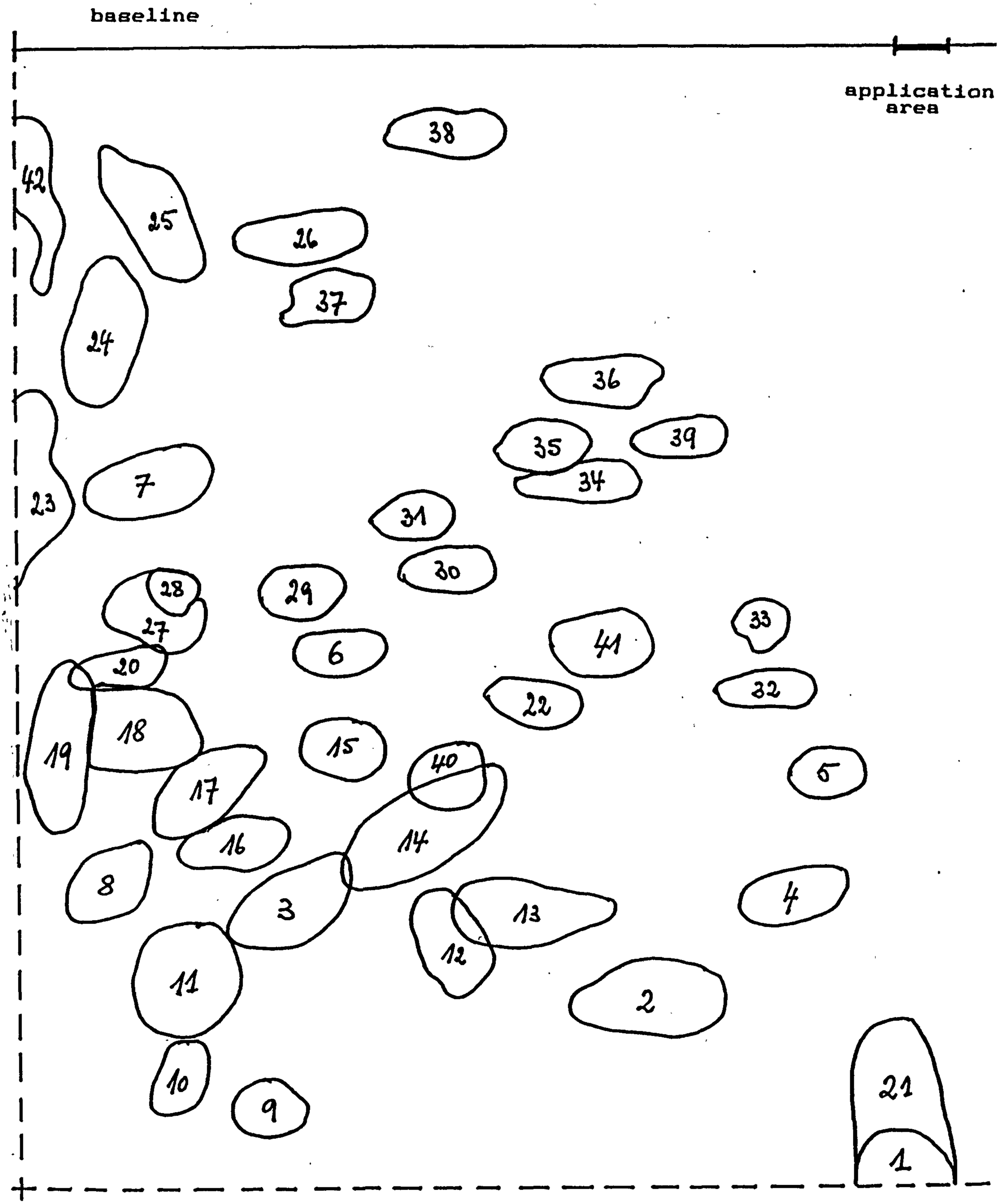


Table 20 : Colour behaviour of flavonoid spots.

Spot Nr.	Colour under UV light (360 nm) without NH_3	with NH_3
01	orange	unchanged
02	orange	yellow
03	orange	unchanged
04	orange	unchanged
05	yellow	unchanged
06	yellow	unchanged
07	yellow	unchanged
08	yellow	unchanged
09	blue	yellow
10	blue	yellow
11	violet	yellow
12	dark blue	yellow
13	green	yellow
14	blue-green	yellow
15	blue	yellow
16	violet	yellow
17	green	yellow
18	blue	yellow
19	blue	yellow
20	blue	yellow
21	violet	unchanged
22	blue	unchanged
23	violet	unchanged
24	blue	unchanged
25	green	unchanged
26	blue	unchanged
27	blue	unchanged
28	blue	unchanged
29	blue	unchanged
30	violet	unchanged
31	violet	unchanged
32	blue-green	unchanged
33	green	unchanged
34	blue	unchanged
35	rose	unchanged
36	blue	unchanged
37	blue	unchanged
38	blue	unchanged
39	white	unchanged
40	blue	unchanged
41	pink	unchanged
42	blue	unchanged

For most taxa, only one individual was examined, indicated by the accession number from paragraph 4. 3. 1. 2. For Olgasis triquetra, Tolumnia pulchella and Tolumnia variegata, 3 different plants each were examined, without finding any variability in the results.

The spots were numbered 1 - 42 and the presence was marked with 1, the absence with 0 in order to obtain data acceptably formatted for computer analyses.

The results scored are combined in the following table.

Table 21 : Presence or absence of flavonoid compounds as scored for usage in computer analysis.

Genus Braasiella (accession number 1)

B. arizajuliana 10000010000110100010000110000010000000l100

Genus Hispaniella (accession number 7)

H. henekenii 00000010000001110000100000000000000000010

Genus Olgasis

O. gauntlettii (accession number 11)
10000010000000000000000000000100000100
O. triquetra (accession numbers 12, 13; 15)
10000010000000000001010110000000000010

Genus Tolumnia

T. bahamensis (accession number 16)
10000010100000000000000110000000100000100
T. calochila (accession number 40)
00000010000000000001000000010000000000100
T. compressicaulis (accession number 45)
10000010000001010000001001000000000000100
T. quianensis (accession number 49)
10000010000010000000101000000000100000010
T. qui. alborubr. (accession number 53)
10000010000010100000101000000000100000010
T. haitiensis (accession number 56)
10000010000011100100001000000000100000000
T. hawkesiana (accession number 19).
10000010000000100000100010010000l100000000
T. leiboldii (accession number 57)
00000010000000000000010010010000010000000
T. lemoniana ssp. lemoniana (accession number 58)
10000010000000000000100010000001000000000
T. lemoniana ssp. guibertiana (accession number 59)
10000000000000000000100010000001000000000
T. lucayana (accession number 60)
10000010000001000000101010000000110000010
T. x osmentii (accession number 78)
10000010000001100000000001000000100000000
T. prionochila (accession number 64)
10000010000000100000000001001000100000010
T. pulchella (accession numbers 65, 67, 68)
10000010000000100010101000010000000l000010
T. quadrilobia (accession number 70)
00000010000000000001010110100001010000000
T. sasseri (accession number 22)
10000010100000100000000011000000100000100
T. scandens (accession number 24)
10000010100000000000000110000000100000100
T. sylvestris (accession number 26)
10000010000001100000000001000000100000000
T. tetrapetala (accession number 74)
00000010000001100000001011000000000000100

T. tuerckheimii (accession number 77)
1001001000001100000000100100000000010000101
T. urophylla (accession number 29)
1000001000000000000001001001000011100001O
T. usneoides (2) 0000001000000100001000000000000000100010
T. variegata (accession numbers 32, 35, 36)
1000001000000010000000101001000101000000O0
T. velutina (accession number 38)
0000011000000010000000001001000101000001O0

Genus Oncidium

a) Section Cebolletae

O. cebolleta (accession number 92)
1000001000010000000010100000100001000000O
O. jonesianum (accession number 93)
1000001000000110001100101100000000000011O
O. nudum (accession number 98)
1000001000000000000000001001000010000010
O. stipitatum (accession number 104)
1000001000000010000010100111000001000000O

b) Section Cimicifera

O. porrigens (accession number 90)
1000001000000000000001000000000100000000

c) Section Crispa

O. macropetalum (accession number 87)
0000000000000000000100000000010100001000

d) Section Excavata

O. excavatum (accession number 86)
1000001000000000000001011001000010000100
O. polyadenum (accession number 89)
0000000000010000000000000000000100000000

e) Section Oblongata

O. schillerianum (accession number 103)
1000001000000000000001011000000100000100

f) Section Plurituberculata

O. bicallosum (accession number 91)
1000001000110000000000000010000010001001O
O. lanceanum (accession number 94)
1000001001110000000000000000000000010010
O. lindeni (accession number 95)
1000001000000010000010001100000000000111
O. morenoi (accession number 96)
0000001000001000000010100100000010000001O

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(2) As no fresh material of this species is available, herbarium material (kindly donated by The Royal Botanic Gdns. Kew) was used.

O. nanum (accession number 97)
1000001000011000000000000001000000010000
O. pumilum (accession number 100)
1000001000000000000010000010000100000110
O. splendidum (accession number 102)
1000001000000000010000100000100000010000010
O. stramineum (accession number 105)
1000001000000110000010000000000000010000

g) Section Pulvinata

O. robustissimum (accession number 101)
1010001000111000000001000000000100000010

h) Section Rostrata

O. cheirophorum (accession number 85)
1000001000000000000010010000000100000100
O. ornithorhynchum (accession number 88)
1000001000000000000010110000000100000000

i) Section Waluewa

O. pubes (accession number 99)
1000001000000100000000000000000011000000

Genus Psychopsiella

P. limminghei (accession number 106)
0000001000100000000000000000000000000000

Genus Psychopsis

P. krameriana (accession number 107)
1000001000100100000000100000000000000000
P. papilio (accession number 108)
1000001001110100000000100000000000000000

Genus Brassia

B. sp. (accession number 80)
1000001000000000000010001000000100000000

Genus Cochlioda

C. noezliana (accession number 81)
0000001000000000011000011000000000000100
C . rosea (accession number 82)
0000000000000010001000000000000000001000

Genus Maxillaria

M. porphyrostele (accession number 83)
1111000000000100001110000000000000000000
M. variabilis (accession number 84)
0011000001110000000000000010000010100000

4. 7. NUMERICAL ANALYSIS

4. 7. 1. INTRODUCTION

The act of sorting similar things into categories is one of the most primitive and common pursuits of mankind and the incorporation of the possibilities of computers in this kind of work has certainly been done ever since computers were invented.

Over the past 25 years there has been a spectacular growth in statistical programs which can be used as an aid to solving biological problems.

It is therefore, not surprising that numeric analysis has also been used in taxonomy, and the principles of numerical taxonomy were outlined by Sokal and Sneath (1963).

The numerical analysis of taxonomic data is dealt with in two phases. During the first phase, a coefficient of similarity is calculated between the the taxa, considered in pairs.

In the second phase, the taxa are arranged in groups by some form of cluster analysis which uses the coefficients of similarity as a starting point.

Different coefficients of similarity and different clustering techniques are combined into a number of computer programs in order to obtain some sort of a dendrogram indicating the phylogenetic relationship between the taxa under examination.

Numerical analysis has been used in orchid taxonomy on several occasions. As far back as 1966, Wirth, Estabrook and Rogers published a graph theory model for systematic biology using a

similarity coefficient which was similar to the single linkage method as described by Sneath (1957) and Sokal & Sneath (1963).

The study of Wirth and his co-workers was performed on several taxa of the Oncidiinae and although no indication was given about what kind of data was used, a comparison of their results and part of the results from this study is definitely of interest (cfr. General Discussion).

The taxonomic affinities of the Neottioideae Garay (1960) [1] using numerical analysis were examined by Laverack (1971) and on the subtribal level computing analysis was used in the Pleurothallidinae by Pridgeon (1982). Laverack as well as Pridgeon used both vegetative and floral characters and whereas Pridgeon used a cluster technique based on Euclidian distance, Laverack compared a whole group of similarity coefficients in his analysis.

The only study I have encountered in plant taxonomy which uses biochemical data as well as morphological characters in a computer-based numerical study was performed on the genus Pyrus by Challice and Westwood (1973). These scientists found that the classification based upon both botanical and chemical characters agreed best with the known geographic distributions of the species.

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(1) in Dressler's System part of the subfamily Epidendroideae.

4. 7. 2. THE COEFFICIENTS OF SIMILARITY

Quite a few similarity or dissimilarity coefficients are available. Some can be used with binary data, others can be used with continuous data and few can be used with mixed (binary and continuous) data.

Most modern programs have the possibility of dealing with missing data. Although this "feature" is propagated as an advantage, its use is very limited.

Using binary data, the computer only differentiates between 0 and 1 and in the case of missing data, 0 is substituted as default value.

Some of these similarity coefficients weigh only the positive matches, others include the negative matches in their computations as well.

4. 7. 3. CLUSTERING METHODS

The program used for the numerical analysis in this study is CLUSTAN (Wishart 1968, 1969). CLUSTAN is a suite of FORTRAN IV programs intended to be used for the collective study and use of cluster analysis. The routines used here, and their purposes are:

1. FILE - This procedure reads the data and calculates principal components.
2. CORREL - A procedure designed to calculate similarity or distance matrices.
3. HIERARCHY - A procedure for general hierarchical agglomerate clustering

4. PLINK - Procedure to plot dendrograms and division trees.

The procedure HIERARCHY within the CLUSTAN program offers a variety of clustering procedures. I have chosen option 6 (Ward's Method) whereby the error sum of squares is defined as the sum of the distances from each individual to the centroid of its parent cluster. This method was initially proposed by Ward (1963) and independently by Orloci (1967), and adapted by Wishart (1969) who considers this method to be the best of the hierarchical options within CLUSTAN (Wishart 1975).

4. 7. 4. DATA

For the purpose of this study I wish to combine botanical data with cytogenetic and biochemical data as well as with data concerning the geographic distributions.
I wanted to examine the relationship between the taxa within the "Variegata" (Analysis I) and the relationship of the "Variegata" to some other groups within the Oncidiinae (Analysis II).
The morphological characters are the classical data used in systematic studies.
The 6 characters of vegetative morphology chosen (see table 12) are easily recognized and do not vary within any one species. The 13 characters of reproductive morphology (table 14) are just as readily recognizable and stable for any one species or in the case of Tolumnia guianensis for any one variety. All morphological characters (integers 1-20 for both analysis) chosen appear to me to have a sound functional ba-

sis.

It is rather evident that a difference in chromosome numbers indicates a phylogenetic separation. I do realize that species should not be differentiated on chromosome numbers alone, but embedded in the whole of the morphological data, this character (analysis I: integers 21-22) aids the differentiation at the specific level.

The chemical data was obtained in order to examine whether that data by itself could substantiate a differentiation system on the specific and generic levels or whether, embedded in the whole of the data (Analysis I: integers 24-65; Analysis II: integers 21-62) the separation performed by the computer would show more clear-cut divisions between the taxa of the "Variegata" (Analysis I) or between the "Variegata" and other groups within the Oncidiinae (Analysis II).

For Analysis I, I have included a geographical character (integer 23). Although I am quite convinced that geographic bounderies cannot be phylogenetic bounderies, I consider the geographical distribution within an archipelago to be a character of some importance. Indeed, the appearance of some species on only 1 island (eg. Olgasis) compared to the much greater distribution of others (eg. Tolumnia variegata) indicates that there are a number of invisible boundaries. The fact that yellow as basic floral colouration is unknown within the species of the "Variegata" in Jamaica is only one example of the questions arising out of the geographical distribution.

As far as the weighting of the data is concerned, I have in Analysis I a 20:2:1:42 ratio (morphology, chrom.num.,geogr. distrib., chemical data). I realize that there is a problem in

obtaining the right weighting of the characters used and I have not attempted to include an artificial and subjective weighting on top of the "automatic" weighting caused by the number of integers which were needed to code for the characters used in the analysis. Instead of this I have run the analysis on each set of data separately as well as together. The results obtained show the importance of each part of the data by itself and in combination with other parts.

A) VEGETATIVE CHARACTERISTICS (see tables 12 and 22)		SCORE
1. Leaf form	a) triquetrous	00
	b) semi-terete	01
	c) terete	11
	d) other	10
2. Leaves distichous or not		1 / 0
3. Pseudobulbs present or not		1 / 0
4. Stolons present or not		1 / 0
5. Keikis produced or not		1 / 0
6. Growth normal or upside down		1 / 0
B) FLORAL CHARACTERISTICS (sse tables 14 and 22)		
7. Peduncle terete / flattened		1 / 0
8. Flower morphology showing "insect mimicry" / not so (figure 3)		1 / 0
9. Callus at base of labellum present / not so (figure 44)		1 / 0
10. Callosities of crest fingerlike / not so (figure 45)		1 / 0
11. Basic colour of labellum yellow /not so		1 / 0
12. Labellum unicoloured / spotted or striped		1 / 0
13. Lateral petals much smaller than labellum / not so		1 / 0
14. Lateral lobes of labellum much smaller than half of the apical lobe / not so		1 / 0
15. Column wings hiding column completely /not so		1 / 0
16. Synsepalum present / lateral petals free		1 / 0
17. ANALYSIS I. Pollinia type A / B ANALYSIS II. Pollinia type A or B/ Other (see page 177).		0 / 1 1 / 0
18. Thickenings on cell borders of seed present /not present		1 / 0
19. Seed capsule smooth and oblong / spheroid and spiny		1 / 0

C) ECOLOGICAL FACTOR

Plant present on 1 single island /on several islands	1 / 0

D) CHROMOSOME (2N) NUMBERS (table 19)

2N = 40	00
2N = 42	01
2N = 84	11
2N = 126	10

Note: For Tolumnia usneoides, a chromosome count is not available. Leaving the score for this character open in numerical analysis would mean that the default setting of 00 is assumed by the computer. This setting however corresponds to 2n = 40. Although I am convinced that the actual chromosome number will prove to be 2n = 40 or 42, the computation of Analysis IB was repeated with settings corresponding to all 4 chromosome counts encountered within the "Variegata". There were no significant differences in the results.

E. CHEMICAL DATA

The presence or absence of each of the 42 recognized spots is scored (table 21)	1 / 0

The numerical analysis is done in two parts:

I. Comparison of the "Variegata".

Analysis a) Morphological characters only
b) Morphological characters and chromosome numbers
c) Morphological characters + chromosome counts + distribution factor (1 or more islands)
d) Chemical data only
e) All data.

II. Comparison of the "Variegata" with related taxa.

Analysis a) Morphological characters only
b) Chemical data only
c) Morphological and chemical data combined.

For the purpose of Analysis II, the taxa 29 through 57 have been examined on the basis of the same morphological characteristics as the "Variegata" The results are shown in the following table.

Table 22 : Morphological characteristics of reference taxa. (not "Variegata")

	leaf form (*)	distichous leaves Y/N	pseudobulbs present Y/N	stolons Y/N	«keikis» Y/N	growth upside down Y/N	peduncle terete Y/N	flower insect-like Y/N	callus of base of lip Y/N	callosities of crest fingerlike Y/N	basic colour of lid yellow Y/N	labellum unicoloured Y/N	lateral petals smaller than ½ of apical lobe of labellum Y/N	lateral lobes of labellum much smaller than ½ apical lobe Y/N	column wings hiding column completely Y/N	synsepalum present Y/N	pollinarium type a or b Y/N	thickenings on cell borders of seed present Y/N	seed capsule smooth and oblong Y/N
Oncidium cebolleta	3	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium jonesianum	3	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	Y	N	N	N	N	Y
Oncidium nudum	3	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium stipitatum	3	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium porrigens	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium macropetalum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	N	Y	N	N	N	N	Y
Oncidium excavatum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium polyadenum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium schillerianum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium bicallosum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium lanceanum	4	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	N	N	Y
Oncidium lindenii	4	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	N	N	Y
Oncidium morenoi	4	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	N	N	Y
Oncidium nanum	4	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	Y	N	N	N	N	Y
Oncidium pumilum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium splendidum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium stramineum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium robustissimum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium cheirophorum	4	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	Y
Oncidium ornithorhynchum	4	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	N	N	Y
Oncidium pubes	4	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	N	N	Y
Psychopsiella limminghei	4	N	Y	N	N	N	Y	Y	Y	N	Y	N	Y	Y	N	N	N	N	Y
Psychopsis krameriana	4	N	Y	N	N	N	Y	Y	Y	N	Y	N	Y	Y	N	N	N	N	Y
Psychopsis papilio	4	N	Y	N	N	N	Y	Y	Y	N	Y	N	Y	Y	N	N	N	N	Y
Brassia sp.	4	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	N	N	Y
Cochlioda noezlina	4	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	N	N	Y
Cochlioda rosea	4	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	N	N	Y
Maxillaria porphyrostele	4	N	Y	N	N	N	Y	N	Y	N	N	N	Y	Y	N	N	N	N	Y
Maxillaria variabilis	4	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	N	N	Y

*) 1 = triquetrous in section, 2 = semi-terete in section, 3 = terete in section, 4 = other in section

Table 23 : Numbering of taxa for computer analysis.

(Taxa 1-28 = "Variegata", taxa 29-57 not "Variegata")

01 Braasiella arizajuliana
02 Hispaniella henekenii
03 Olgasis gauntlettii
04 Olgasis triquetra
05 Tolumnia bahamensis
06 Tolumnia calochila
07 Tolumnia compressicaulis
08 Tolumnia guianensis
09 Tolumnia guianensis var. alborubrum
10 Tolumnia haitiensis
11 Tolumnia hawkesiana
12 Tolumnia leiboldii
13 Tolumnia lemoniana ssp. lemoniana
14 Tolumnia lemoniana ssp. guibertiana
15 Tolumnia lucayana
16 Tolumnia x osmentii
17 Tolumnia prionochila
18 Tolumnia pulchella
19 Tolumnia quadrilobia
20 Tolumnia sasseri
21 Tolumnia scandens
22 Tolumnia sylvestris
23 Tolumnia tetrapetala
24 Tolumnia tuerckheimii
25 Tolumnia urophylla
26 Tolumnia usneoides
27 Tolumnia variegata
28 Tolumnia velutina
29 Oncidium cebolleta
30 Oncidium jonesianum
31 Oncidium nudum
32 Oncidium stipitatum
33 Oncidium porrigens
34 Oncidium macropetalum
35 Oncidium excavatum
36 Oncidium polyadenum
37 Oncidium schillerianum
38 Oncidium bicallosum
39 Oncidium lanceanum
40 Oncidium lindenii
41 Oncidium morenoi
42 Oncidium nanum
43 Oncidium pumilum
44 Oncidium splendidum
45 Oncidium stramineum
46 Oncidium robustissimum
47 Oncidium cheirophorum
48 Oncidium ornithorhynchum
49 Oncidium pubes
50 Psychopsiella limminghei
51 Psychopsis krameriana
52 Psychopsis papilio
53 Brassia sp.
54 Cochlioda noezliana
55 Cochlioda rosea

56 Maxillaria porphyrostele
57 Maxillaria variabilis

4. 7. 5. RESULTS

Figures 124 to 131 show the plotted dendrograms corresponding to each analysis.

Figure 124 : Dendrogram of analysis I A.
Comparison of the "Variegata" using
morphological data only.

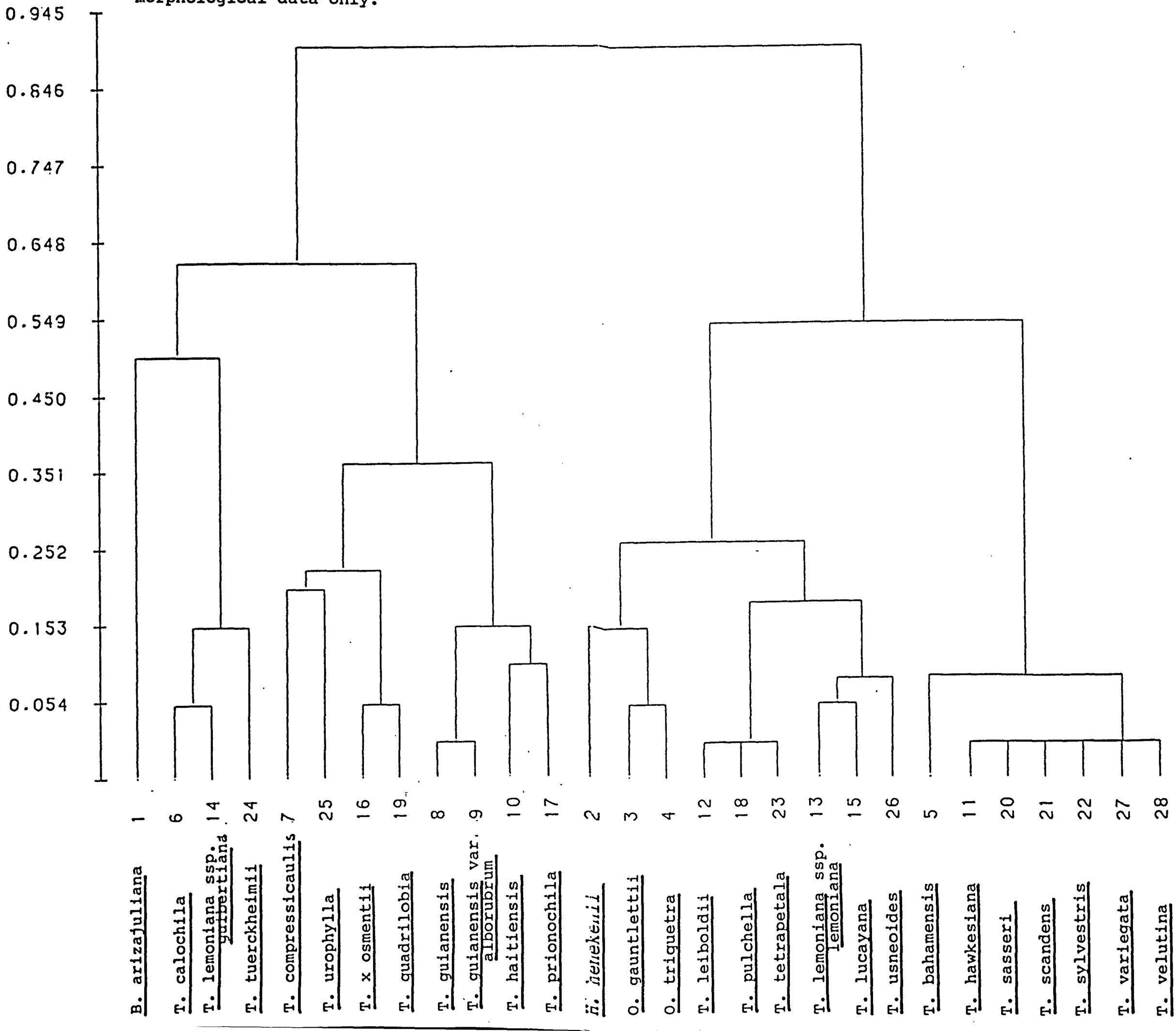


Figure 125 : Dendrogram of analysis I B.
Comparison of the "Variegata" using
morphological data and chromosome numbers.

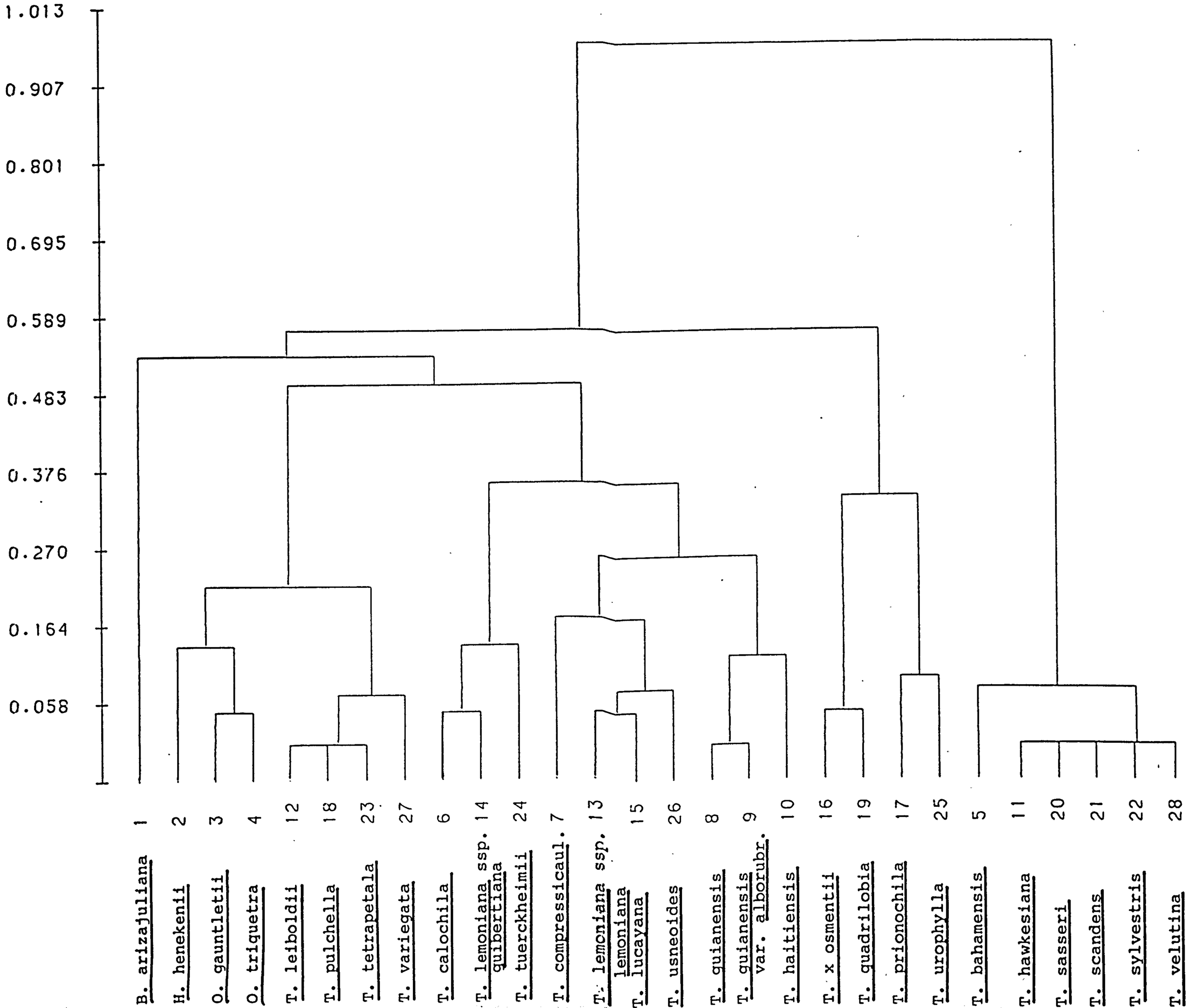


Figure 126 : Dendrogram of analysis I C.
Comparison of the "Variegata" using morphological data, chromosome numbers and distribution factor.

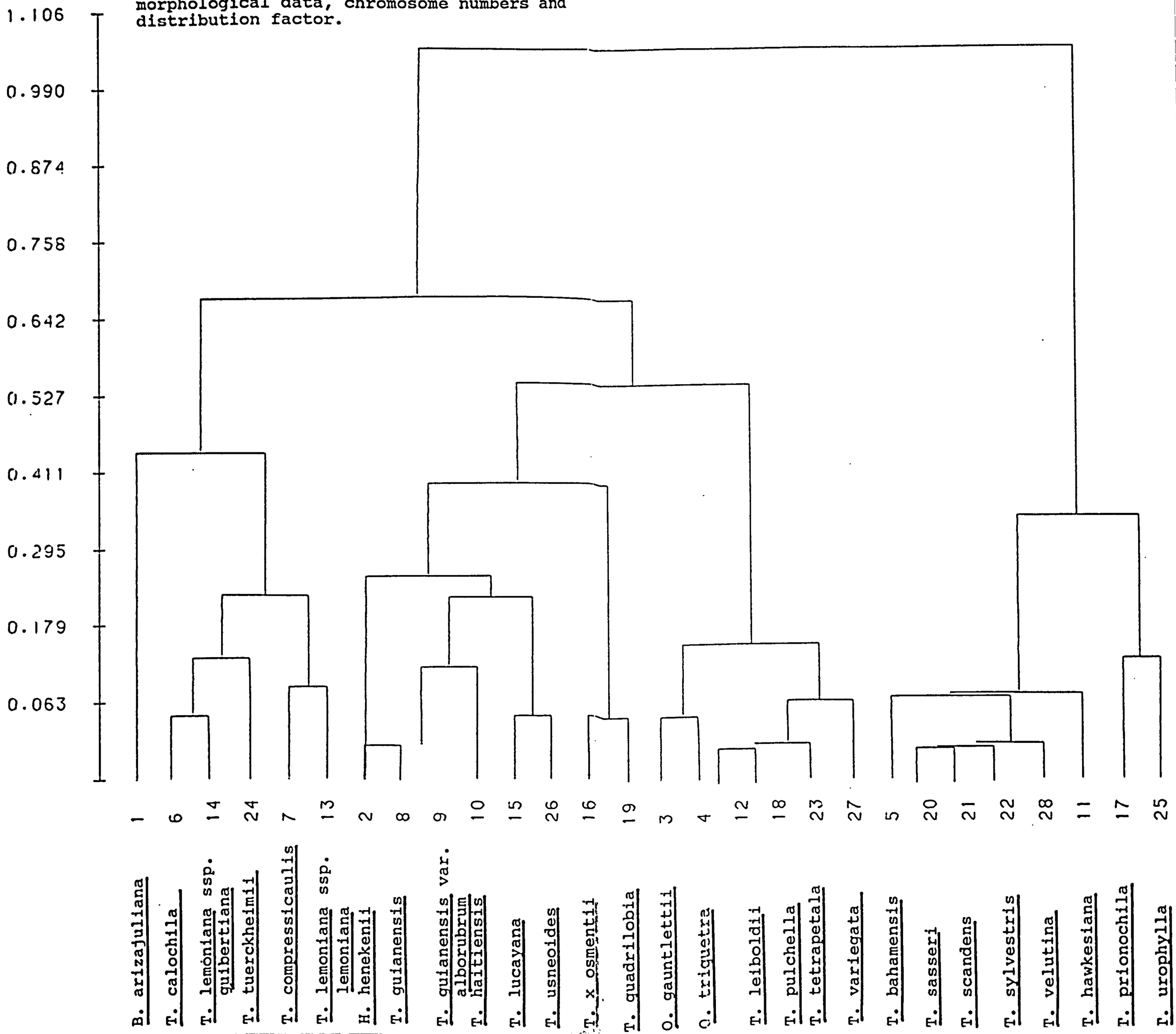


Figure 127 : Dendrogram of analysis I D.
Comparison of the "Variegata" using chemical data only.

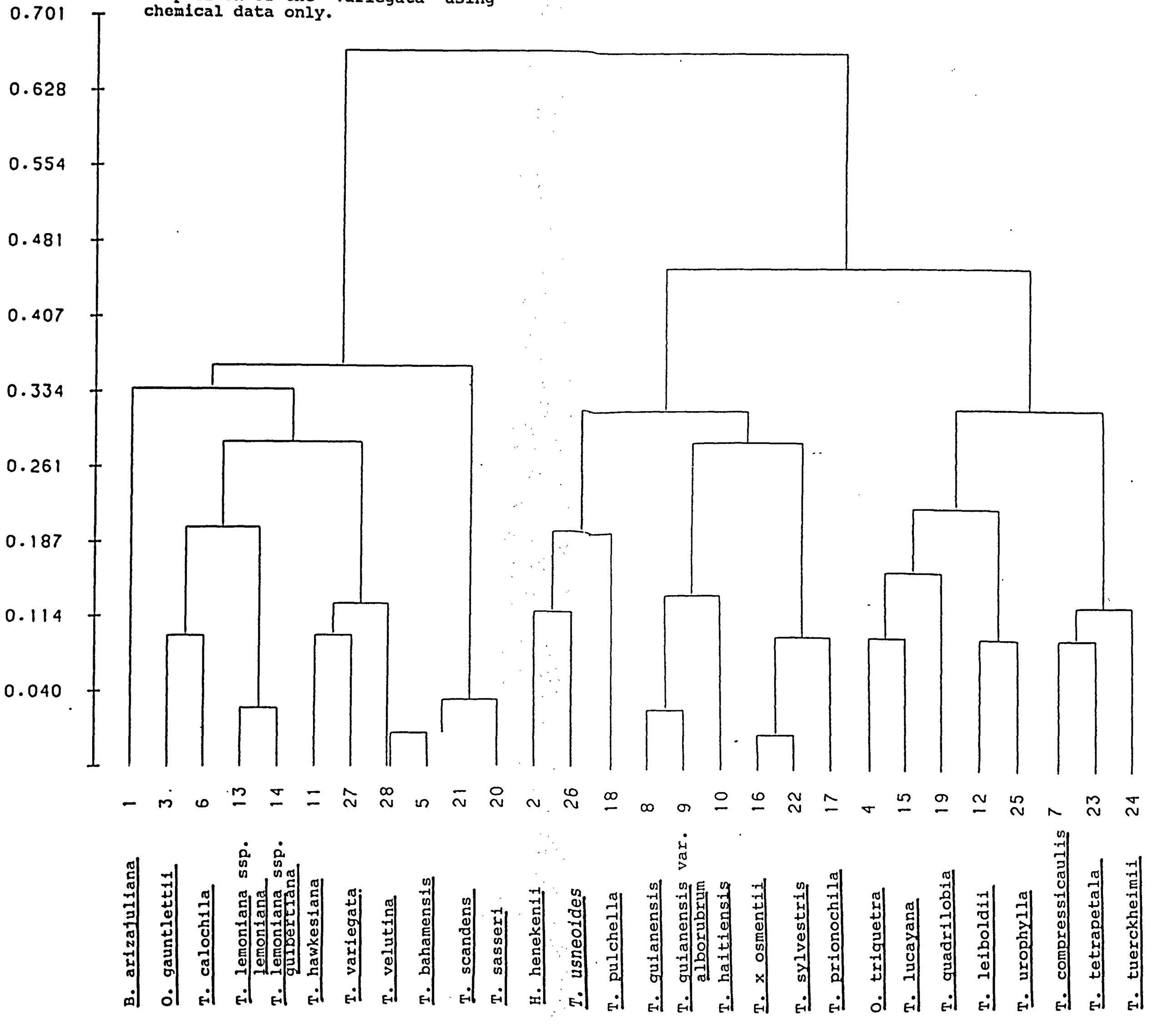


Figure 128 : Dendrogram of analysis I E.
Comparison of the "Variegata" using all data.

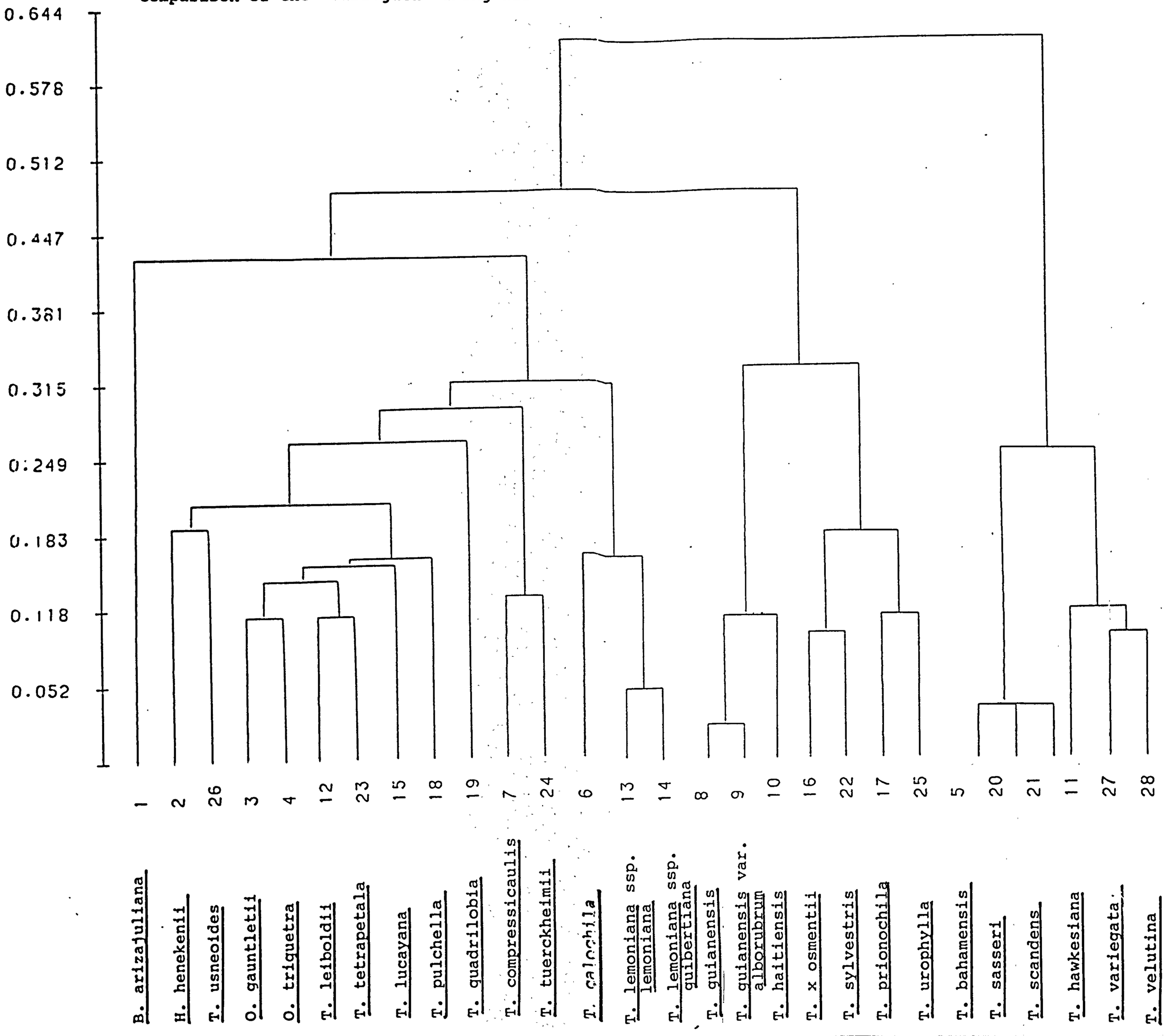


Figure 129 : Dendrogram of analysis II A.
Comparison of the "Variegata" with related taxa
using morphological characters only.

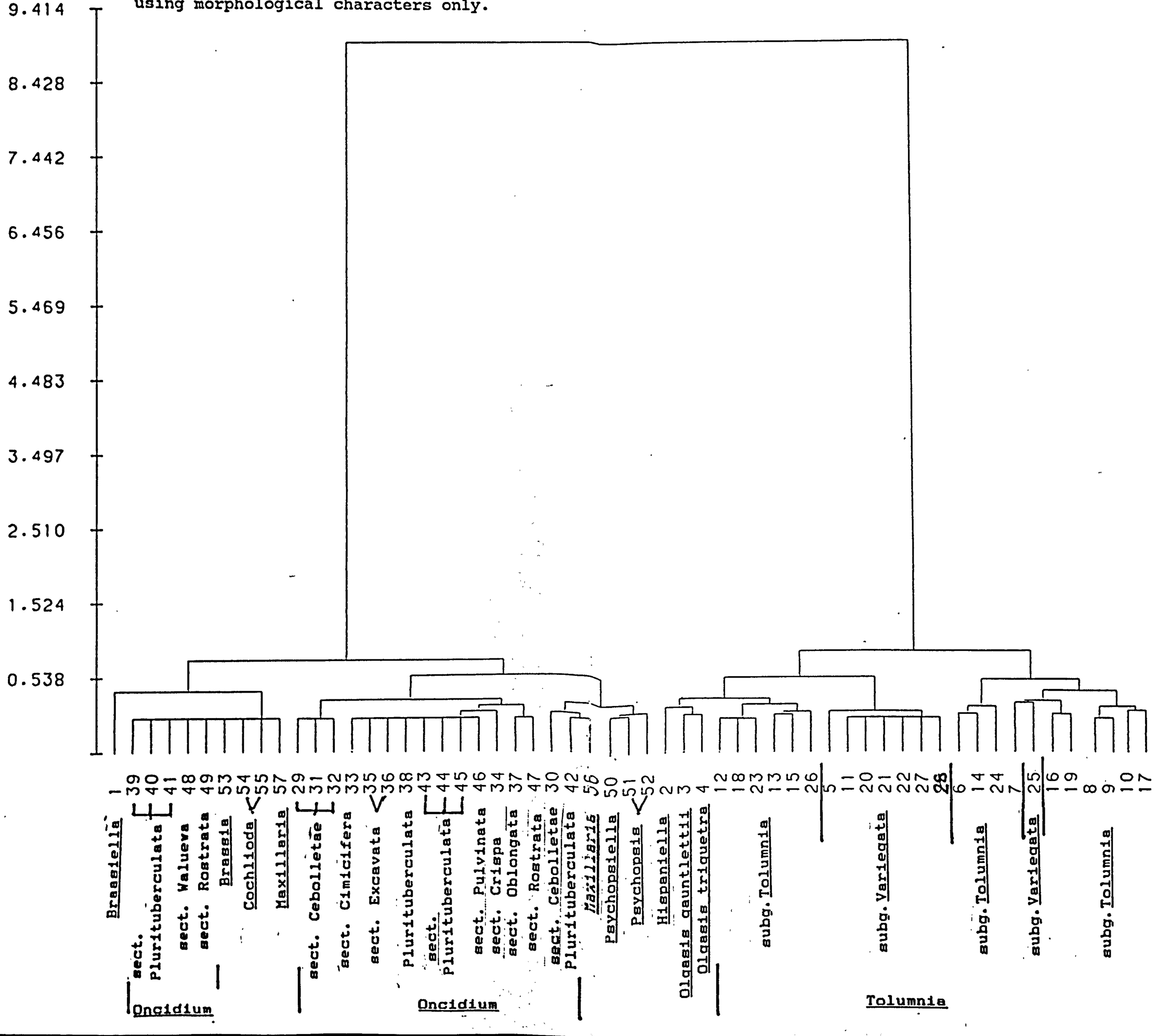


Figure 130 : Dendrogram of analysis II B.
Comparison of the "Variegata" with related taxa
using chemical data only.

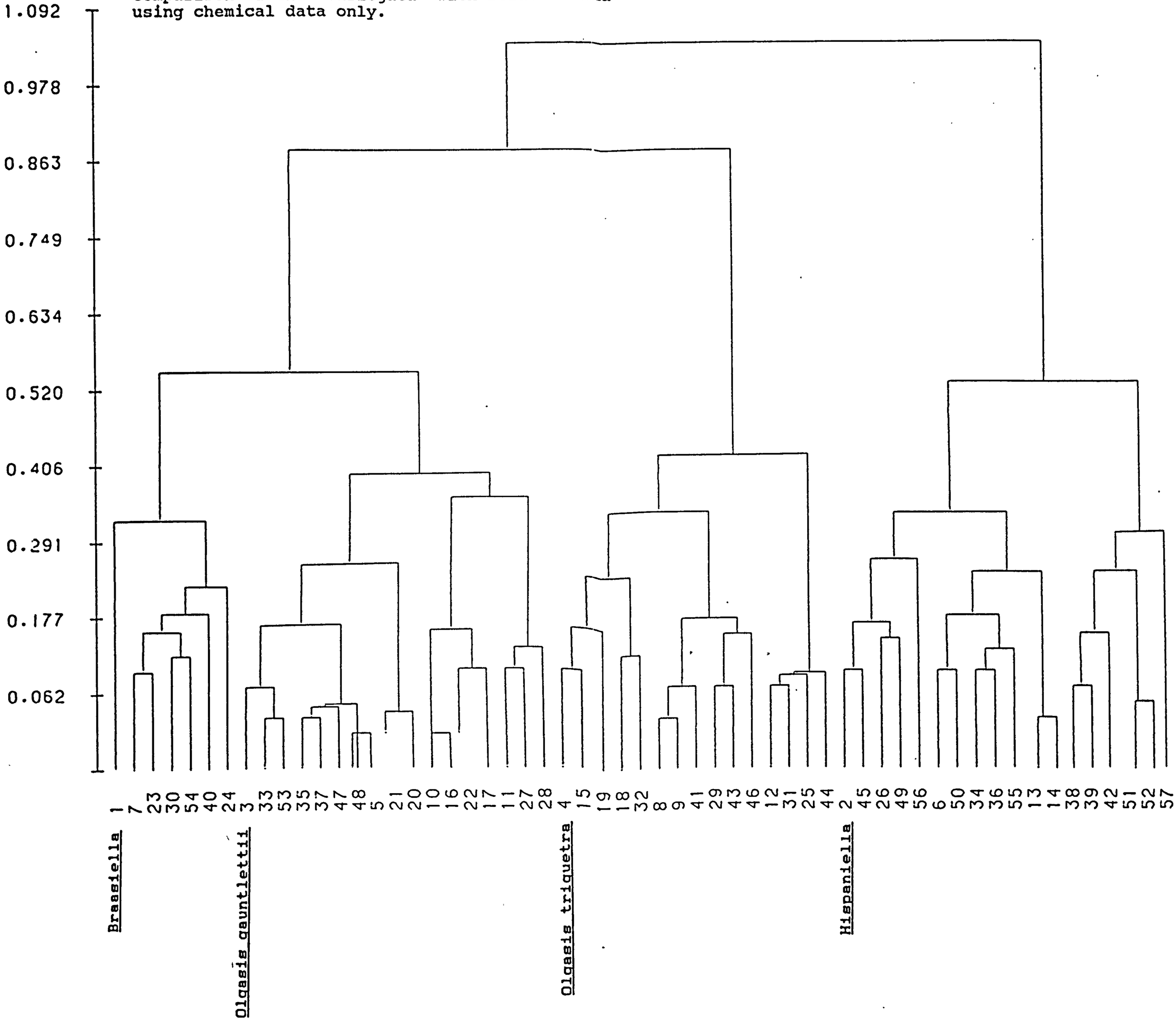
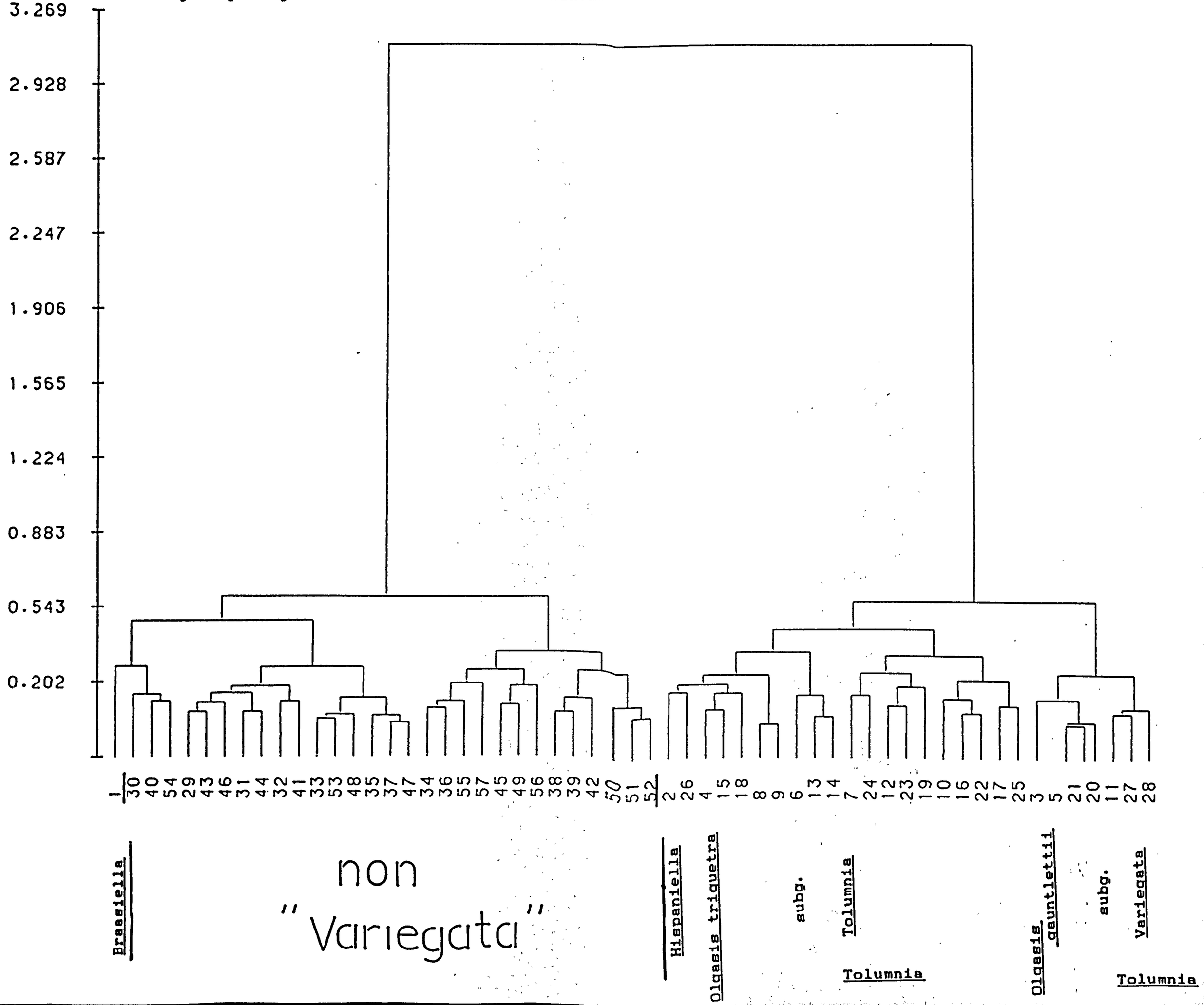


Figure 131 : Dendrogram of analysis II C.
Comparison of the "Variegata" with related taxa
using morphological and chemical data combined.



4. 7. 6. DISCUSSION

Using morphological characters only (Analysis I A), the plot (Fig. 124) shows a fairly clear separation of the species of the "Variegata" examined into two groups.
On the left hand side there are the yellow and white and yellow flowered species of Tolumnia subgenus Tolumnia together with Braasiella arizajuliana (Withner & Jimenez) Braem.
On the other side we find Hispaniella henekenii (Schomb. ex Lindley) Braem grouped together with the two Olgasis-species and all but one of the stoloniferous Tolumnia species (subgenus Variegata). Tolumnia urophylla (Loddiges ex Lindley) Braem has been clustered together with the other yellow flowering species by the analysis.
The grouping together of the terete leafed variety of Tolumnia lemoniana (Tolumnia lemoniana ssp. guibertiana) and Tolumnia calochila, as well as the indicated close relationship of these two species to Tolumnia tuerckheimii, indicate that vegetative characters alone are not sufficient to differentiate phylogenetically at the species level.

When we combine morphological data with cytogenetic data (chromosome numbers) the differentiation becomes more clear (Analysis I B, fig. 125). Repeating the analysis with a chromosome score for Tolumnia usneoides corresponding to the counts encountered within the "Variegata" did not show any pertinent changes in the results.
In all of the four variants of the analysis, Tolumnia usneoides was clustered closest to the triquetrous leafed variant of Tolumnia lemoniana (Tolumnia lemoniana ssp. lemoniana)

and Tolumnia compressicaulis.

This analysis shows a clear separation of Braasiella arizajuliana from all other "Variegata". The Olgasis-species are clustered together and set besides Hispaniella henekenii.

In all four variants of this analysis, close relationships are shown between within the following groups of the genus Tolumnia

Group A. Tolumnia leiboldii (subgenus Tolumnia)
Tolumnia pulchella (subgenus Tolumnia)
Tolumnia tetrapetala (subgenus Tolumnia)
Tolumnia variegata (subgenus Variegata)

This group was obviously clustered on the basis of the chromosome count 2n=42. As this group includes the stoloniferous Tolumnia variegata (subgenus Variegata) it is clear that the analysis weights the chromosome count more than growth habit although both characteristics are scored by two integers.

Group B. Tolumnia calochila
Tolumnia lemoniana ssp. guibertiana
Tolumnia tuerckheimii
(all subgenus Tolumnia)

This grouping clearly results out of the combination of flower colour, the leaf morphology and chromosome counts (2n=42), although the chromosome number was weighted less than the other criteria by the data matrix.

Group C. Tolumnia lemoniana ssp. lemoniana

Tolumnia lucayana

Tolumnia usneoides

Tolumnia compressicaulis

(all subgenus Tolumnia)

This group is based mainly on flower colour, although here again the chromosome counts (2n=40,42) and to some extent the leaf morphology are correlated.

Group D. Tolumnia guianensis

Tolumnia guianensis var. alborubrum

Tolumnia haitiensis

(all subgenus Tolumnia)

There is no doubt about the strong affinity between Tolumnia guianensis and its variety alborubrum. Tolumnia haitiensis sits close to these species as suggested by the corresponding chromosome count (2n=42).

Group E.	Tolumnia x osmentii	(subgenus Tolumnia)
	Tolumnia quadrilobia	(subgenus Tolumnia)
	Tolumnia prionochila	(subgenus Tolumnia)
	Tolumnia urophylla	(subgenus Variegata)

Here again, four yellow flowered species are grouped together, although phylogenetically, Tolumnia haitiensis is more related to Tolumnia x osmentii and Tolumnia quadrilobia than the two species grouped with them.

Group F. Tolumnia bahamensis

Tolumnia hawkesiana

Tolumnia sasseri

Tolumnia scandens

Tolumnia sylvestris

Tolumnia velutina

(all subgenus Variegata)

Here, the clustering clearly results from of the combination of the chromosome count of 2n=84 or 126 with the stoloniferous growth habit. Only the yellow flowered Oncidium urophyllum is not included in this group, indicating that flower colour, although scored only by one single integer has been emphasized more than chromosome count. This group contains all other members of subgenus Variegata apart from Tolumnia variegata itself.

Adding the distribution data to the morphological and cytogenetic characteristics (Analysis I C) gives no further results which could be interpreted as phylogenetic groupings within the "Variegata" (Figure 126).

Analysis I D was performed on biochemical data (Flavonoid fingerprinting) only. The results (Figure 127) show clustering which cannot be interpreted as being clearcut phylogenetic groups.

Braasiella arizajuliana is separated from all other taxa as would be expected. Hispaniella henekenii and Tolumnia usneoides are grouped together although the only common feature is that they are different from all other plants examined. Tolumnia calochila is grouped together with Olgasis gauntlet-

tii although no relationship of any kind can be based on any other characteristics.

Although Tolumnia hawkesianum, Tolumnia variegatum and Tolumnia velutina are grouped together as well as Tolumnia bahamense, Tolumnia sasseri and Tolumnia scandens, these two closely related groups are separated by the program from each other and from the remaining stoloniferous species Tolumnia sylvestre, which is grouped together with Tolumnia x osmentii and Tolumnia prionochilum, and Tolumnia urophylla, which is clustered with Tolumnia leiboldii.

The overall results show a total of 26 clusters. Of these only two at very low level (Tolumnia lemoniana ssp. guibertiana with Tolumnia lemoniana ssp. lemoniana and Tolumnia guianensis with Tolumnia guianensis var. alborubrum) can be considered to indicate close phylogenetic relationships. In fact, each of these two is the grouping of varieties of one single species. All other clusters do not indicate clearcut phylogenetic groups within the "Variegata".

Concluding, it can be said that flavonoid fingerprinting is not a useful taxonomic marker at the species level, as far as it is considered on its own.

All data available was combined for analysis I E. Here the plotted dendrogram (Figure 128) shows a fairly clearcut separation within the "Variegata" as in analysis I B, indicating that the data of the flavonoid fingerprinting has no negative effect on the overall data.

At the highest level, all stoloniferous species (subgenus Variegata) with the exception of Tolumnia sylvestris and Tolumnia urophylla are separated as one group from all other plants

under investigation. Within this first group, the results suggest a close relationship between Tolumnia variegata and Tolumnia velutina as well as between Tolumnia bahamensis, Tolumnia sasseri and Tolumnia scandens. The positioning of Tolumnia hawkesiana between these two complexes indicates its special status due to its chromosome number of 2n=126.

The second group at this clustering level is again divided into two fairly clearcut complexes, the one consisting of species which have a special standing due to some unique morphological character.

Tolumnia guianensis and Tolumnia haitiensis were apparently grouped together because of their corresponding chromosome numbers. As for analysis I D, Tolumnia sylvestris and Tolumnia urophylla are not grouped with the other stoloniferous species, they are grouped together with the related species Tolumnia prionochilum and set close to each other Tolumnia prionochila and Tolumnia urophylla both have yellow coloured flowers, produce Keikis and have a chromosome count of 2n=84.

The reason for the close clustering of Tolumnia x osmentii and Tolumnia sylvestris is unknown to me.

Within the other complex, Braasiella arizajuliana, Hispaniella henekenii and the Olgasis-species are clearly separated from all other "Variegata", although the separation is at different levels. The results indicate that the Olgasis-species are much closer related to the "Variegata" than Hispaniella and Braasiella are, and that Hispaniella, again, has a closer affinity to the other species of the group than does Braasiella.

Tolumnia usneoides is placed as most closely related to Hispaniella henekenii, demonstrating its distinct status due to its leaf- and flower morphology.

Within the rest of this complex, a close relationship between Tolumnia leiboldii and Tolumnia tetrapetala is indicated, as well as a close relationship between Tolumnia compressicaulis and Tolumnia tuerckheimii.

Analysis II was made to investigate the relationship of the "Variegata" to other members of the Oncidiinae.

Analysis II A. was based on the 20 vegetative characters as listed above. The results are plotted in figure 129.
Braasiella is clearly separated from the "Variegata" and seems most closely related to Maxillaria and Cochlioda.
Although Hispaniella and Olgasis are distinctly separated from the other "Variegata", their close affinity to Tolumnia is indicated.
THE DISTINCTION OF ALL "VARIEGATA" FROM ALL OTHER TAXA, INCLUDING ONCIDIUM SENSU BRAEM IS VERY CLEAR, AND UPHOLDS THE DECISION TO MAINTAIN THESE TAXA IN SEPARATE GENERA.

Analysis II B. is based on chemical data (leaf flavonoids) only. The results as depicted in figure 130 show no clear cut separation of the "Variegata" as a distinct group. Only the genus Braasiella is clearly clustered distinctly from all other groups at a high level, indicating its valid autonomous status.
As in analysis I D, the results here again indicate that leaf flavonoid fingerprinting is not a valid taxonomic marker on the infrageneric level when used by its own.

Analysis II C combines the data as used for analysis II A. and

II B.

The plot in figure 131 shows a distinct separation of the genera Hispaniella, Olgasis and Tolumnia from all other groups of the Oncidiinae. The distinct status of Braasiella as indicated in analysis II A. is again clearly indicated.

ONCE AGAIN, THE "VARIEGATA" ARE SHOWN TO BE DISTINCT FROM ONCIDIUM.

The results of the numerical analysis show:

1. The "Variegata" is a distinct group, clearly separated from all other sections of the genus Oncidium sensu Garay and Stacy as well as from all other genera within the Oncidiinae.

2. The genera Braasiella, Hispaniella, Olgasis and Tolumnia are not entirely supported as valid autonomous entities within the "Variegata". The relationship of Braasiella to the other "Variegata" is less close than the relationship of Hispaniella, Olgasis and Tolumnia to each other.

5. GENERAL DISCUSSION

This study formed a revision of the plants formerly referred to Oncidium section Oncidium in the Caribbean Islands using a combination of morphological, cytogenetical and chemical data and a geographic pointer.

The data was not weighted by me because of the known difficulty concerning the objectivity in selecting characters for a systematic study. There was however a definite weighting performed by the numerical system which resulted out of the restrictions in the possibility of the coding of each character. It was, for example, not possible to code the 4 different leaf forms with one integer, just as it was impossible to code the different chromosome numbers encountered in such a way. For the chemical study, each of the 42 recognized spots had to be coded for.

As far as the morphological characters are concerned, this study is restricted to those characters which are genetically stable within the species studied and which are easily recognized, characteristic for the taxa studied, and clearly definable. In most cases, the morphological characters displayed a clear adaptive function of some kind. The choice of selecting these clearcut characters augment the objectivity of the study. Characters of vegetative morphology as well as characters of generative morphology were chosen.

The study shows the major importance of the morphological characters. In fact, on the base of these morphological characters alone, a fairly clearcut separation of the different phy-

logenetical groups within the "Variegata" is possible. This strongly supports the maintenance of the higher taxa Braasiella, Hispaniella, Olgasis, Tolumnia subgenus Tolumnia and Tolumnia subgenus Variegata.

The cytogenetic information given by the chromosome counts augments the reliability of the separation performed on the basis of morphological characters, whereas the use of a geographical marker does not seem to alter the results significantly.

The chemical data by itself cannot be considered useful for systematic studies in the sense of this study. This data indicates however that most orchids have flavonoid compounds which may be useful when studied in connection with other data.

The analysis of the data obtained by employing numerical methods proves to be useful. Such a study can however never be entirely objective, as the results also depend on the choice of the characters examined and the weighting by the researcher, or by the program due to the coding possibilities and restrictions.

It is my opinion that a systematic study is best done on morphological characters, and that other data such as chromosome numbers and chemical markers should only be included as an aid in those cases where the morphology does not allow for a clearcut decision.

This study shows the autonomous status of the genus Braasiella on the basis of a large number of morphological characters.

Not only is the vegetative habit different from that of all other species examined in this study, but especially the flower morphology with its beaklike rostellum and the subsequent form of the pollinarium indicate clearly that the taxon does not fit into any other genus.

The results of this study confirm the opinion of most orchid researchers that the group of orchids formerly referred to as Oncidium section Oncidium or "Variegata" is clearly different from all other groups within that genus. The differences are to be found in vegetative morphology as well as in flower morphology and, to a large extent, in different chromosome numbers. Their geographic isolation is another indication of their divergence from all other orchids. The separation of the "Variegata" from Oncidium sensu Garay and Stacy is therefore supported. As Rafinesque already separated Oncidium pulchellum as Tolumnia pulchella in 1837, the latter genus should be recognized.

On the basis of floral morphology, the genus Hispaniella as well as the genus Olgasis was separated before this study was started. The results of this examination show that Hispaniella is unique in its floral morphology, resembling a bee. This form of adaptation can only be compared with the floral characteristics of the European genus Ophrys. Therefore Hispaniella is indeed divergent enough to warrant its separation as an autonomous genus.

The genus Olgasis was separated from the genus Oncidium as far back as 1837 by Rafinesque on the basis of the missing callus on the base of the labellum. This study shows that this sepa-

ration can be supported.

Because of a major difference in vegetative morphology, the genus Tolumnia was separated into two subgenera. This is largely but not totally supported by the numerical analysis. The first subgenus consists of all non-stoloniferous species, more or less morphologically identical with the type species Tolumnia pulchella. The species of this subgenus have chromosome numbers 2n = 40, 42.

Within this group there is one species (Tolumnia lemoniana) which shows two different forms as far as their leaf morphology is concerned. I have therefore separated it into two subspecies as Tolumnia lemoniana ssp. lemoniana (with triquetrous leaves) and Tolumnia lemoniana ssp. guibertiana (with terete leaves).

The second subgenus is based around Tolumnia variegata. The plants of this subgenus are characterized by a stoloniferous growth habit. The chromosome numbers are 2n = 42, 84, 126. Within this subgenus, the species differ mainly by their chromosome number. It may be possible to treat all these species as varieties of one species.

As far as the evolution within this group of plants is concerned (Figure 132), I believe that the "Variegata", with the exception of Braasiella arizajuliana, arose from a non-stoloniferous "Oncidiinae-like" orchid with a chromosome number of 2n = 42. The population "based" in the Caribbean Islands gradually developed and split up into a number of different groups. Hispaniella henekenii adapted to insect mimicry and

probably left the "main track" before the bulk of the species separated into stoloniferous and non-stoloniferous complexes. The chromosome count of 2n = 40 may be due to the loss of two chromosomes in the course of this evolution. In the genus Olgasis, the floral structure may also have adapted to a specific pollinator who did not respond to the tuberculite callus on the basis of the lip. As yet, this pollinator is unknown.

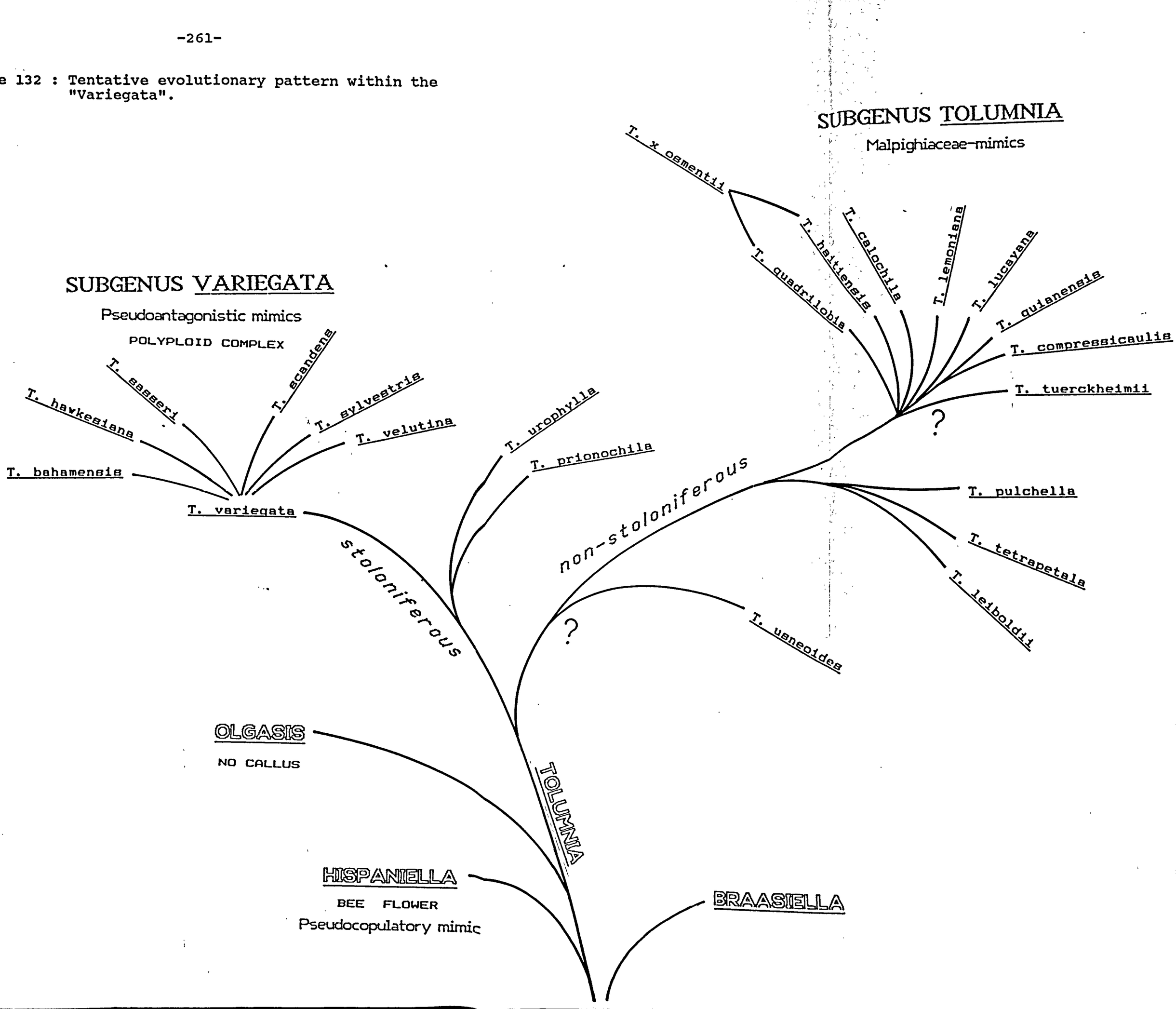
The rest of the "Variegata" split up into two major complexes. Part of the plants remained non-stoloniferous. The other part adapted to the stoloniferous growth habit, possibly due to the adaptation to pollination through pseudoantagonism (Tolumnia variegata). The stoloniferous habit allows plants to hang from trees in such a way that flowers are suspended in the air, mimicking a territorial male bee. One part of this complex went its own way and adapted to flower (Malpighiaceae) mimicry (Tolumnia urophylla and Tolumnia prionochila.)

The development of the tetraploids (Tolumnia bahamensis, Tolumnia sasseri, Tolumnia scandens, Tolumnia sylvestris and Tolumnia velutina) and the hexaploid (Tolumnia hawkesiana) taxa from the diploid stoloniferous Tolumnia variegata was the next step. The difference in the chromosome number in isolated populations might impose reproductive isolation within a fairly short time and lead to the future divergence of these taxa.

The non-stoloniferous group again split up into two complexes. On the one hand, there are those species which have adapted to flower mimicry (Tolumnia guianensis, Tolumnia quadrilobia etc.) and which are easily recognized by their mainly yellow flower colour. On the other hand there are Tolumnia pulchella, Tolumnia tetrapetala and Tolumnia leiboldii.

Of course, there are number of question marks in this scheme. For instance, where do Tolumnia tuerckheimii and Tolumnia usneoides fit in? It is possible that Tolumnia tuerckheimii developed together with the other yellow flowered species but because of the fact that no thickenings to the cell borders of the seed occur, I believe rather that the origin of Tolumnia tuerckheimii is not the same as that of the other members of the genus Tolumnia. As far as Tolumnia usneoides is concerned, nothing definite can be said until enough fresh material can be examined. It is quite conceivable that both of these taxa, like Braasiella arizajuliana, developed independently from all other plants studied. This might mean that it would be better to separate them as autonomous monospecific genera.

Figure 132 : Tentative evolutionary pattern within the "Variegata".



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ANNEX I

List of plants described as Oncidium-species with indication of synonomy and reference to the sections of Oncidium sensu Garay and Stacy (1974)

ABERRANS SCHLTR.	PAUCITUBERCULATA
ABORTIVUM RCHB.F.	HETERANTHA
ABRUPTUM LINDEN AND RCHB.F. EX KRZL.	PLANILABRIA
ACINACEUM LINDLEY	HETERANTHA
ACROBOTRYUM KLOTZSCH	= HARRISONIANUM LINDLEY
ACROCHORDONIA RCHB.F. EX KRZL.	PLANIFOLIA
ADVENA RCHB.F.	PLANIFOLIA
AEMULUM RCHB.F. AND WARSC.	CYRTOCHILUM
AEQUINOCTIALE STACY	CUCULLATA
ALATUM COGN.	= MEIRAX RCHB.F.
ALBINII SCHLTR.	WALUEWA
ALBOVIOLACEUM RICH. AND GAL.	= INCURVUM BARKER EX LINDLEY
ALCICORNE RCHB.F.	ROSTRATA
ALFREDI KRZL.	= COGNIAUXIANUM SCHLTR.
ALLEMANII BARB. RODR.	= PSYGMORCHIS ALLEMANII (BARB. RODR.) GARAY AND STACY
ALOISII SCHLTR.	PLANILABRIA
ALTICOLA STACY	CUCULLATA
ALTISSIMUM (JACQUIN) SWARTZ	PLANILABRE
AMABILE RCHB.F.	PLANIFOLIA
AMICTUM LINDLEY	WALUEWA
AMOENUM RICH. AND GAL.	PAUCITUBERCULATA
AMPLIATUM LINDLEY	OBLONGATA
AMPLIATUM LINDLEY VAR. MAJUS	OBLONGATA
ANCEPS (KLOTZSCH) RCHB.F.	= MILTONIA ANCEPS (KLOTZSCH) RCHB.F.
ANDIGENUM LINDEN AND RCHB.F.	CUCULLATA
ANFRACTUM ROLFE	= REICHENBACHII LINDLEY
ANGUSTISEPALUM KRZL.	ROSTRATA
ANNULARE RCHB.F.	CYRTOCHILUM
ANOMALUM RCHB.F.	VERRUCITUBERCULATA
ANSIFERUM RCHB.F.	PLANIFOLIA
ANTHEROTES RCHB.F.	= BRASSIA ANTHEROTES RCHB.F.
ANTHOCRENE RCHB.F.	PLANILABRIA
ANTIOQUIENSE KRZL.	OBLONGATA
APICULATUM MOIR	= TOLUMNIA TETRAPETALA (JACQUIN) BRAEM
APTERUM (LLAVE AND LEX.) BEER	= ODONTOGLOSSUM APTERUM LLAVE AND LEX.
ARIETINUM KRZL.	= STRAMINEUM BATEM. EX LINDLEY

ARIZAJULIANUM WITH. AND JIM. = BRAASIELLA ARIZAJULIANA (WITH. & JIM.) BRAEM
ARMILLARE LINDLEY = AURIFERUM RCHB.F.
ARTICULATUM RAND = PSYGMORCHIS GLOSSOMYSTAX (RCHB.F.) DODSON AND DRESSLER
ASCENDENS LINDLEY CEBOLLETAE
ASPARAGOIDES KRZL. = HETERANTHUM POEPP. AND ENDL.
ATROPURPUREM (RCHB.F.) BEER = ODONTOGLOSSUM AUROPURPUREUM RCHB.F.
AURARIUM RCHB.F. STELLATA
AUREUM LINDLEY = ONDONTOGLOSSUM AUREUM (LINDLEY) GARAY
AURICULA (VELL.) PABST = HARRISONIANUM LINDLEY
AURIFERUM RCHB.F. VERRUCITUBERCULATA
AURISASINORUM STANDL. AND WMS. PLURITUBERCULATA
AUROSUM RCHB.F. = EXCAVATUM LINDLEY
AZUAYENSE KRZL. = NUBIGENUM LINDLEY
BACATUM GARAY AND DUNSTERVILLE HETERANTHA
BAHAMENSE NASH EX BRITT. & MILLSP. = TOLUMNIA BAHAMENSE (NASH EX BRITT. & MILLSP.) BRAEM
BAHIENSE (COGN.) SCHLTR. = CILIATUM LINDLEY
BALDEVIAMAE RCHB.F. CYRTOCHILUM
BALLII ROLFE CIMICIFERA
BARAHONENSIS HORT. EX MOIR = TOLUMNIA GUIANENSE (AUBL.) BRAEM
BARBACENIAE LINDLEY SYNSEPALA
BARBATUM LINDLEY BARBATA
BARKERI LINDLEY = TIGRINUM LLAVE AND LEX.
BATEMANIANUM PARM. EX KNOWL. AND WESTC. VERRUCITUBERCULATA
BAUERI LINDLEY PLANIFOLIA
BERENYCE RCHB.F. = TOLUMNIA TETRAPETALA (JACQUIN) BRAEM
BERNOULLIANUM KRZL. = AMPLIATUM LINDLEY
BEYRODTIANUM SCHLTR. SYNSEPALA
BICALLOSUM LINDLEY PLURITUBERCULATA
BICAMERATUM RCHB.F. EX KRZL. = BAUERI LINDLEY
BICOLOR LINDLEY SYNSEPALA
BICORNUTUM HOOK. = PUBES LINDLEY
BIDENS (LINDLEY) RCHB.F. = BRASSIA BIDENS LINDLEY
BIDENTATUM ROLFE PLANILABRIA
BIFLORUM BARB. RODR. = LONGIPES LINDLEY
BIFOLIUM SIMS SYNSEPALA
BIFRONS LINDLEY = WARZEWICZII RCHB.F.
BILAMELLATUM KRZL. = ANOMALUM RCHB.F.

BLANCHETTII RCHB.F.
BLOSSFELDIANUM SCHLTR.
BLUNTII RCHB.F.

BOISSIERI KRZL.
BOLIVIANENSE OPPENH.
BOLIVIANUM SCHLTR.
BOLIVIENSE ROLFE

BOOTHIANUM RCHB.F.
BOYDII HORT. EX LINDLEY

BRACHIATUM (LINDLEY) RCHB.F.

BRACHYANDRUM LINDLEY
BRACHYPHYLLUM LINDLEY

BRACHYPTERUM LINDEN AND RCHB.F.
BRACHYSTACHYS KRZL.
BRACHYSTEGIUM KRZL.

BRACTEATUM RCHB.F. AND WARSZ.
BRASSIA RCHB.F.

BRAUNII REGEL
BRENESII SCHLTR.
BREVIFOLIUM RICH. AND GAL.
BREVILABRUM ROLFE
BRIENIANUM RCHB.F.
BRUNLEESIANUM RCHB.F.

BRUNNIPETALUM BARB. RODR.
BRYOCLADIUM SCHLTR.
BRYOLOPHOTUM RCHB.F.

BUCHTIENII SCHLTR.
CABAGRAE SCHLTR.
CAESIUM RCHB.F.
CAJAMARCAE SCHLTR.
CALANTHUM RCHB.F.
CALDENSE RCHB.F.
CALLISTUM RCHB.F. EX KRZL.
CALOBULBON LINDEN AND RCHB.F.

CALOCHILUM COGN.

CALOGLOSSUM RCHB.F.
CALYPTOSTALIX KRZL.

CAMINIOPHORUM RCHB.F.
CANDELLABRUM LINDLEY EX BEER

CANDIDUM (LINDLEY) RCHB.F.

SYNSEPALA
= BARBATUM LINDLEY
= MILTONIA BLUNTII RCHB.F.
= EXCAVATUM LINDLEY
= ASCENDENS LINDLEY
= BAUERI LINDLEY
= BATEMANIANUM PARM. EX KNOWL. AND WESTC.
EXCAVATA
= ALTISSIMUM (JACQ.) SW.
= BRASSIA VERRUCOSA LINDLEY
CONCOLORIA
= CEBOLLETA (JACQ.) SW.
CYRTOCHILUM
CIMICIFERA
= BATEMANIANUM PARM. EX KNOWL. AND WESTC.
PLANIFOLIA
= BRASSIA MACULATA R.BROWN
ROSTRATA
= OBRYZATUM RCHB.F.
= REFLEXUM LINDLEY
HETERANTHA
= WIDGRENII LINDLEY
= BAPTISTONIA ECHINATA BARB. RODR.
SYNSEPALA
HETERANTHA
= HETHERANTHUM POEPP. AND ENDL.
EXCAVATA
OBLONGATA
= NEBULOSUM LINDLEY
= FOVEATUM LINDLEY
HETERANTHA
= RAMOSUM LINDLEY
VERRUCITUBERCULATA
= PLANILABRE LINDLEY
= TOLUMNIA CALOCHILA (COGN.) BRAEM
= PECTORALE LINDLEY
= TETRASKELIDION KRZL.
OBLONGATA
= ODONTOGLOSSUM CORONARIUM LINDLEY
= MILTONIA CANDIDA LINDLEY

CANDIDUM LINDLEY
= PALUMBINA CANDIDA (LINDLEY) RCHB.F.

CARDERI RCHB.F.
= VENTILABRUM RCHB.F. AND WARSC.

CARDIOCHILUM LINDLEY
= OCHMATOCHILUM RCHB.F.

CARDIOSTIGMA RCHB.F.
PLANIFOLIA

CARIBENSE MOIR
= TOLUMNIA LEIBOLDII (RCHB.F.) BRAEM

CARINATUM KNOWL. AND WESTC.
= LEOCHILUS CARINATUS (KNOWL. AND WESTC.) LINDLEY

CARINIFERUM (RCHB.F.) BEER
= ODONTOGLOSSUM CARINIFERUM RCHB.F.

CARTHAGENENSE (JACQ.) SW.
PLURITUBERCULATA

CARTHAGENENSE (JACQ.) SW. VAR. OERSTEDII RCHB.F.
PLURITUBERCULATA

CASTANEUM RCHB.F. EX KRZL.
= CABAGRAE SCHLTR.

CAUCANUM SCHLTR.
OBLONGATA

CAUDATUM (L.) RCHB.F.
= BRASSIA CAUDATA (L.) LINDLEY

CAVENDISHIANUM BATEM.
PLURITUBERCULATA

CAYMANENSE MOIR
= TOLUMNIA LEIBOLDII (RCHB.F.) BRAEM

CEBOLLETA (JACQ.) SW.
CEBOLLETAE

CEBORETUM SW.
= CEBOLLETA (JACQ.) SW.

CELSIANUM A. RICH.
= BIFOLIUM SIMS

CELSISSIMUM HOFFMGG.
PLANIFOLIA

CHRYSORHAPIS RCHB.F.
WALUEWA

CHRYSORNIS RCHB.F.
ROSTRATA

CHRYSOTHYRSUS RCHB.F. AND WARSC.
SYNSEPALA

CILIATUM LINDLEY
BARBATA

CILIOLATUM HOFFMGG.
= BARBATUM LINDLEY

CIMICIFERUM RCHB.F.
CIMICIFERA

CINNABARINUM (LINDLEY) RCHB.F.
= ADA AURANTIACA LINDLEY

CIRRHOSUM (LINDLEY) BEER
= ODONTOGLOSSUM CIRRHOSUM LINDLEY

CITRINUM LINDLEY
OBLONGATA

CITROSMUM (LINDLEY) BEER
= ODONTOGLOSSUM PENDULUM (LLAVE AND LEX.) BATEM. ORGYALE RCHB.F. AND WARSZ.

CLAESII ROLFE
STELLATA

CLOWESII (LINDLEY) BEER
CIMICIFERA

COCCIFERUM RCHB.F. AND WARSC.
= ODONTOGLOSSUM COCHLEATUM (LINDLEY) RCHB.F.

COCHLEATUM LINDLEY
= ODONTOGLOSSUM ROSSII LINDLEY

COERULLESCENS (RICH. AND GAL.) BEER
OBLONGATA

COGNIAUXIANUM SCHLTR.

COMPRESSICAULIS WITHNER	= TOLUMNIA COMPRESSICAULE (WITHNER) BRAEM
CONCAVUM MOIR	= TOLUMNIA PULCHELLA (HOOKER) BRAEM
CONCOLOR HOOK.	CONCOLORIA
CONFRAGOSUM LINDLEY	= VIPERINUM LINDLEY
CONFUSUM RCHB.F.	= ENSATUM LINDLEY
CONSTRICTUM (LINDLEY) BEER	= ODONTOGLOSSUM CONSTRICTUM LINDLEY
CONVOLVULACEUM LINDLEY AND PAXTON	= GLOBULIFERUM H.B.K.
CORDATUM LINDLEY	CYRTOCHILUM
CORNIGERUM LINDLEY	WALUEWA
CORONARIUM (LINDLEY) BEER	= ODONTOGLOSSUM CHIRIQUENSE RCHB.F.
CORYMBIPHORUM MOOR.	???
CORYNEPHORUM LINDLEY	= VOLUBILE (POEPP. AND ENDLICH.) COGNIAUX
CORYNOPHORUM LINDLEY VAR. MUELLERI HORT	= VOLUBILE (POEPP. AND ENDLICH.) COGNNIAUX
COSTARICENSE SCHLTR.	PLANIFOLIA
COSTATUM (LINDLEY) BEER	CYRTOCHILUM
COSYMBEFORUM MORREN	= ALTISSIMUM (JACQ.) SWARTZ
CRISPUM LODDIGES	CRISPA
CRISPUM LODDIGES VAR. FLAVUM HORT.	CRISPA
CRISPUM LODDIGES VAR. GRANDIFLORUM HORT.	CRISPA
CRISPUM LODDIGES VAR. SUBLEAVE	CRISPA
CRISPUM LODDIGES VAR. RODRIGUESII COGN.	CRISPA
CRISPUM LODDIGES VAR. LIONETIANUM COGN.	CRISPA
CRISTA-GALLI RCHB.F.	DISTICHA
CRISTATELLUM GARAY	ROSTRATA
CRISTATUM (LINDLEY) BEER	= ODONTOGLOSSUM CRISTATUM LINDLEY
CRISTATUM ROLFE	= CRISTATELLUM GARAY
CROCODILICEPS RCHB.F.	= LEOCHILUS CROCODILICEPS (RCHB.F.) KRZL.
CROESUS RCHB.F.	BARBATA
CRUCIATUM RCHB.F.	WALUEWA
CRUCIFERUM RCHB.F. AND WARSZ.	PLANIFOLIA
CRUENTUM HORT. EX VEITCH	= REFLEXUM LINDLEY
CRYPTOCOPIS RCHB.	CYRTOCHILUM
CUCULLATUM LINDLEY	= OLIVACEUM H.B.K.
CUCULLATUM LINDLEY VAR. GIGANTEUM HORT.	= OLIVACEUM H.B.K.
CUCULLATUM LINDLEY VAR. NUBIGENUM	= NUBIGENUM LINDLEY
CUCULLATUM LINDLEY VAR. PHALAENOPSIS	= PHALAENOPSIS LINDEN AND RCHB.F.
CUENCANUM RCHB.F.	HETERANTHA
CULTRATUM LINDLEY	HETERANTHA

CUNEATUM (LINDLEY) BEER = SPECIOSUM (KLOTZSCH) RCHB.F.

CUNEATUM LINDLEY = ALTISSIMUM (JACQ.) SWARTZ

CUNEATUM SCHEIDW. = REMOTIFLORUM GARAY

CUNEILABIUM MOIR = TOLUMNIA TETRAPETALA (JACQUIN) BRAEM

CURTUM LINDLEY CRISPA

CYCNICOLLE RCHB.F. EX LINDEN HETERANTHA ROSTRATA

DACTYLIFERUM GARAY AND DUNST. HETERANTHA

DACTYLOPTERUM RCHB.F. = CHRYSOMORPHUM LINDLEY

DASYANTHUM KRZL. CONCOLORIA

= FALCIPETALUM LINDLEY

DASYSTYLE RCHB.F. CUCULLATA

DAVISII RCHB.F. = CRISTA-GALLI RCHB.F.

DAYANUM (RCHB.F.) STACY ROSTRATA

DECIPIENS LINDLEY = ANSIFERUM RCHB.F.

DELTOIDEUM LINDLEY = ODONTOGLOSSUM DENSIFLORUM LINDLEY

DELUMBE LINDLEY = MICROPOGON RCHB.F.

DENSIFLORUM (LINDLEY) BEER = LEOCHILUS DEPAUPERATUS (LEHM. AND KRZL.) KRZL.

DENTATUM KLOTZSCH = TOLUMNIA GUIANENSE (AUBL.) BRAEM

DEPAUPERATUM LEHM. AND KRZL. CYRTOCHILUM

= SERRATUM LINDLEY

DESERTORUM NASH EX WITHNER = ERYCINA DIAPHANA (RCHB.F.) SCHLTR.

DETORTUM RCHB.F. CYRTOCHILUM

DIADEMA LINDEN OBLONGATA

DIAPHANUM RCHB.F. = ODONTOGLOSSUM AUREUM (LINDLEY) GARAY

DICERATUM LINDLEY = CHEIROPHORUM RCHB.F.

DICHROMATICUM RCHB.F. = XANTHORNIS RCHB.F.

DICHROMUM ROLFE = LEUCOCHILUM BATEM.

DIELSIANUM KRZL. = TRULLIFERUM LINDLEY

DIFFUSUM C. SCHWEINF. CIMICIFERA

DIGITATUM LINDLEY = ODONTOGLOSSUM DIPTERUM LINDLEY

DIMORPHUM REGEL CONCOLORIA VERRUCITUBERCULATA

DIODON RCHB.F.

DIPTERUM (LINDLEY) BEER

DISCIFEREUM LINDLEY

DISCOBULBON KRZL.

DISTANS (RCHB.F.) BEER	= ODONTOGLOSSUM DISTANS RCHB.F.
DIVARICATUM LINDLEY	PULVINATA
DIVARICATUM VAR. CUPREUM LINDLEY	PULVINATA
DONIANUM BATEM. EX BAXT.	VERRUCITUBERCULATA
DREPANOPTERUM KRZL.	OBLONGATA
DUBIUM ANDRE	= OLGASIS TRIQUETRA (SWARTZ) BRAEM
DUNSTERVILLEORUM FOLDATS	= SYMPHYGLOSSUM SPEC.
DURANGENSE HAGSATER	OBLONGATA
DUVEENII FOWLIE	????
EBRACHIATUM A. AND S.	= NUDUM BATEM.
ECHINATUM (BARB. RODR.) COGN.	= BAPTISTONIA ECHINATA BARB. RODR.
ECHINATUM H.B.K.	= ERYCINA ECHINATA (H.B.K.) LINDLEY
ECHINOPHORUM BARB. RODR.	= PSYCHOPSIELLA LIMMINGHEI (MORREN) LUECKEL AND BRAEM
EDMUNDOI PABST	SYNSEPALA
EDWALLII COGN.	PAUCITUBERCULATA
EGERTONII (LINDLEY) BEER	= OSMOGLOSSUM EGERTONII (LINDLEY) SCHLTR.
EHRENBERGII (LINK, KL. AND OTTO) BEER	= ODONTOGLOSSUM EHRENBERGII LINK, KL. AND OTTO
ELEGANS (HAMILTON) BEER	= TETRAMICRA ELEGANS (HAMILTON) COGN.
ELEGANTISSIMUM RCHB.F.	= GARDNERI LINDLEY
ELEPHANTOTIS RCHB.F.	ROSTRATA
EMARGINATUM MEYER	= EPIDENDRUM STENOPETALUM HOOK.
EMILII SCHLTR.	BARBATA
ENDERIANUM HORT.	CRISPA
ENDOCHARIS RCHB.F.	CONCOLORIA
ENGELII RCHB.F.	CYRTOCHILUM
ENGLERANUM KRZL.	CYRTOCHILUM
ENSATUM LINDLEY	PLANIFOLIA
EPHIPPIUM RCHB.F.	= ENSATUM LINDLEY
EPIDENDROIDES (H.B.K.) BEER	= ODONTOGLOSSUM EPIDENDROIDES H.B.K.
EROSILABIUM STACY	CUCULLATA
EROSUM (RICH. AND GAL.) BEER	= ODONTOGLOSSUM STELLATUM LINDLEY
ESTRADAE DODSON	CONCOLORIA
EUODES RCHB.F.	= BRASSIA EUODES RCHB.F.
EURYCLINE RCHB.F.	BARBATA
EUXANTHINUM RCHB.F.	= VARICOSUM LINDLEY
EXALATUM HAGSATER	ROSTRATA
EXAMINANS LINDLEY	ROSTRATA
EXASPERATUM LINDEN AND RCHB.F.	CIMICIFERA

EXCAVATUM LINDLEY	EXCAVATA
FALCICORNE KRZL.	= HAPALOTYLE SCHLTR.
FALCIPETALUM LINDLEY	CYRTOCHILUM
FALLENS RCHB.F.	CYRTOCHILUM
FASCICULATUM HAGSATER	OBLONGATA
FASCIFERUM RCHB.F. AND WARSC.	PLANIFOLIA
FERREIRIANUM ST. LEGER	= SPILOPTERUM LINDLEY
FORBESII HOOKER	CRISPA
FORBESII VAR. MOORTEBEEKIENSE HORT.	CRISPA
FORBESII HOOK. VAR. MAXIMUM LINDEN AND RODIGAS	CRISPA
FORCIPETALUM (LINDEN AND RCHB.F.) SCHNEE	= ODONTOGLOSSUM MEGALOPHIUM LINDLEY
FORKELII SCHEIDW.	= ALTISSIMUM (JACQ.) SWARTZ
FORMOSISSIMUM RCHB.F.	HETERANTHA
FOVEATUM LINDLEY	VERRUCITUBERCULATA
FRACTIFLEXUM LEHM. AND KRZL.	= ODONTOGLOSSUM FRACTUM RCHB.F.
FULGENS SCHLTR.	= OBRYZATUM RCHB.F.
FUNEREUM LLAVE AND LEX.	= MACULATUM (LINDLEY) LINDLEY
FUNIS LEHM. AND KRZL.	= ODONTOGLOSSUM FUNIS (LEHM. AND KRZL.) GARAY
FUSCANS RCHB.F.	SYNSEPALA
FUSCATUM RCHB.F.	= MILTONIA WARSCEWICZII RCHB.F.
FUSCOPETALUM (HOEHNE) GARAY AND STACY	SYNSEPALA
GALEATUM SCHEIDW.	= TRULLIFERUM LINDLEY
GALEOTTIANUM (A. RICH.) BEER	= ODONTOGLOSSUM GALEOTTIANUM A. RICH.
GALEOTTIANUM DRAP.	= ODONTOGLOSSUM PENDULUM (LLAVE AND LEX.) BATEM.
GALLOPAVINUM MORREN	= BATEMANIANUM PARM. EX KNOWL. AND WESTC.
GARDNERI LINDLEY	CRISPA
GARGANTUA RCHB.F.	CYRTOCHILUM
GAUNTLETTII WITHNER AND JESUP	= OLGASIS GAUNTLETTII (WITHNER AND JESUP) BRAEM
GAUTIERI REGEL	= LONGICORNU MUTEL
GEERTIANUM MORREN	= NEBULOSUM LINDLEY
GERAENSE BARB. RODR.	= VARICOSUM LINDLEY
GHIESBREGHTIANUM RICH. AND GAL.	= MEXICOA GHIESBREGHTIANA (RICH. AND GAL.) GARAY
GHILLANYI PABST	= SPILOPTERUM LINDLEY

GILVUM (VELL.) PABST GIREOUDIANUM RCHB.F.	WALUEWA = BRASSIA GIREOUDIANA RCHB.F. = CEBOLLETA (JACQ.) SWARTZ SERPENTIA
GLAZIOVII COGN.	
GLOBULIFERUM H.B.K. GLOBULIFERUM H.B.K. VAR. COSTARICENSE RCHB.F. GLOSSOMYSTAX RCHB.F.	SERPENTIA = PSYGMORCHIS GLOSSOMYSTAX (RCHB.F.) DODSON AND DRESSLER
GLUMACEUM (LINDLEY) RCHB.F.	= BRASSIA GLUMACEA LINDLEY
GNOMUS KRZL.	= PSYGMORCHIS GNOMA (KRZL.) DODSON AND DRESSLER
GODSEFFIANUM KRZL.	= FIMBRIATUM LINDLEY
GOMESII COGN.	= WARMINGII RCHB.F.
GRACILE LINDLEY	CONCOLORIA
GRACILIFORME SCHWEINF.	EXCAVATA
GRACILLIMUM COGN.	= COGNIAUXIANUM SCHLTR.
GRACILLIMUM ROLFE	= ALCICORNE RCHB.F.
GRAMINIFOLIUM LINDLEY	= BRACHYANDRUM LINDLEY
GRANDE	????
GRANDIFLORUM RCHB.F.	CYRTOCHILUM
GRAVESIANUM ROLFE	CRISPA
GUATEMALENSE SCHLTR.	= OLIGANTHUM (RCHB.F.) L.O. WMS.
GUIANENSE (AUBL.) GARAY	= TOLUMNIA GUIANENSE (AUBLET) BRAEM
GUIANENSE (AUBL.) GARAY VAR. AUREORUBRUM MOIR	= TOLUMNIA GUIANENSE (AUBLET) BRAEM
GUIANENSE (AUBL.) GARAY VAR. ALBORUBRUM MOIR AND HAWKES	= TOLUMNIA GUIANENSE (AUBLET) BRAEM
GUIANENSE (AUBL.) GARAY VAR. ALBUM MOIR AND HAWKES	= TOLUMNIA GUIANENSE (AUBLET) BRAEM
GUIBERTIANUM A. RICH.	= TOLUMNIA LEMONIANA (LINDLEY) BRAEM
GUNDLACHII WRIGHT EX GRISEB.	= ANTILLANORCHIS GUNDLACHII (WRIGHT EX GRISEB.) GARAY
GUTTATUM FAWCETT AND RENDLE	= TOLUMNIA TETRAPETALA (JACQUIN) BRAEM

GUTTATUM RCHB.F.	= LURIDUM LINDLEY
GUTTATUM RCHB.F. VAR. OLIVACEUM	= LURIDUM LINDLEY
GUTTATUM RCHB.F. VAR. ROSEUM HORT.	= LURIDUM LINDLEY
GUTTULATUM RCHB.F.	= BAUERI LINDLEY
GYRIFERUM RCHB.F.	CYRTOCHILUM
GYROBULBON RCHB.F.	OBLONGATA
HAEMATOCHILUM LINDLEY AND PAXTON	PLURITUBERCULATA
HAEMATOCHRYSUM RCHB.F.	= FLEXUOSUM SIMS
HAEMATOXANTHUM RCHB.F. EX LINDLEY	= FLEXUOSUM SIMS
HAITIENSE LEONARD AND AMES EX AMES	= TOLUMNIA HAITIENSE (LEONARD & AMES EX AMES) BRAEM
HALLII (LINDLEY) BEER	= ODONTOGLOSSUM HALLII LINDLEY
HALTERATUM LINDLEY	CYRTOCHILUM
HAPALOTYLE SCHLTR.	ROSTRATA
HARRISONIAE LODDIGES	= HARRISONIANUM LINDLEY
HARRISONIANUM LINDLEY	PULVINATA
HARTWEGII LINDLEY	ROSTRATA
HARTWEGII LINDLEY VAR. PARVIFLORUM	ROSTRATA
HASSLERI COGN.	= LONGIPES LINDLEY AND PAXTON
HASTATUM LINDLEY	STELLATA
HASTIFERUM RCHB.F. AND WARSC.	= MACRANTHUM LINDLEY
HASTILABIUM (LINDLEY) BEER	= ODONTOGLOSSUM HASTILABIUM LINDLEY
HATSCHBACHII SCHLTR.	= PARANAENSE RCHB.F.
HAWKESIANUM MOIR	= TOLUMNIA HAWKESIANUM (MOIR) BRAEM
HEBRAICUM RCHB.F.	ROSTRATA
HECATANTHUM KRZL.	= FIMBRIATUM LINDLEY
HEDYOSMUM SCHLTR.	= OBRYZATUM RCHB.F.
HELENAE RCHB.F.	= BRASSIA WARSCEWICZII RCHB.F.
HELICANTHUM KRZL.	= ASCENDENS LINDLEY
HEMICHRYSUM (RCHB.F. AND WARSC.) RCHB.F.	= ODONTOGLOSSUM AUREUM (LINDLEY) GARAY
HENCHMANNII LOOD.	= CARTHAGENENSE (JACQUIN) SWARTZ
HENEKENII SCHOMB. EX LINDLEY	= HISPANIELLA HENEKENII (SCHOMB. EX LINDLEY) BRAEM
HENRICI-GUSTAVI KRZL.	PLANIFOLIA
HERBACEUM (LINDLEY) RCHB.F.	= LEOCHILUS HERBACEUS LINDLEY
HERZOGII SCHLTR.	BARBATA
HETERANTHUM POEPP. AND ENDLICH.	HETERANTHA
HETERODACTYLUM KRZL.	= PENTADACTYLON LINDLEY

HIANS LINDLEY	PAUCITUBERCULATA
HIEROGLYPHICUM RCHB.F. AND WARSC.	OBLONGATA
HINTONII L.O.WMS.	= MACULATUM (LINDLEY) LINDLEY
HIRUNDO RCHB.F.	PLANILABRIA
HOEHNEANUM SCHLTR. EX MANSF.	= COGNIAUXIANUM SCHLTR.
	= ONUSTUM LINDLEY
HOLOCHRYSUM RCHB.F.	= PSYGMORCHIS
HONDURENSE AMES	HONDURENSE (AMES) GARAY AND STACY
HOOKERI ROLFE	PAUCITUBERCULATA
HOOKERI ROLFE VAR. ALBESCENS PABST	PAUCITUBERCULATA
HOPPII SCHLTR.	= OBRYZATUM RCHB.F.
HRUBYANUM RCHB.F.	= LIETZEI REGEL
HUEBSCHII RCHB.F.	= MELANOPS RCHB.F.
HUMBOLDTII SCHLTR.	= CEBOLLETA (JACQUIN) SWARTZ
HUNTIANUM HOOK.	= CARTHAGENENSE (JACQUIN) SWARTZ
HYALINOBULBON LLAVE AND LEX.	= LEOCHILUS HYALINOBULBON (LLAVE AND LEX.) SCHLTR.
HYDROPHILUM BARB. RODR.	SYNSEPALA
HYPHAEMATICUM RCHB.F.	CONCOLORIA
IMBRICATUM (LINDLEY) RCHB.F.	= BRASSIA IMBRICATA LINDLEY
IMPERATORIS-MAXIMILIANA RCHB.F.	CRISPA
INCARUM (KRZL.) C. SCHWEINF.	CYRTOCHILUM
INCURVUM BARKER EX LINDLEY	PLANIFOLIA
INCURVUM BARKER EX LINDLEY VAR. ALBUM LINDEN	PLANIFOLIA
INFERLOBUM HORT.	= SUPERBIENS RCHB.F.
INSCULPTUM RCHB.F.	CYRTOCHILUM
INSLEAYI BARKER EX LINDLEY	= ODONTOGLOSSUM INSLEAYI (BARKER EX LINDLEY) LINDLEY
INSLEAYI BARKER EX LINDLEY VAR. LEOPARDINUM REGEL	= ODONTOGLOSSUM INSLEAYI (BARKER EX LINDLEY) LINDLEY
INSLEAYI BARKER EX LINDLEY VAR. SPLENDENS RCHB.F.	= ODONTOGLOSSUM INSLEAYI (BARKER EX LINDLEY) LINDLEY
INTERMEDIUM BERTERO EX SPRENG.	= TOLUMNIA GUIANENSE (AUBLET) BRAEM
INTERMEDIUM KNOWL. AND WESTC.	= LURIDUM LINDLEY
IONODON RCHB.F.	= FALCIPETALUM LINDLEY
IONOPS COGN. AND ROLFE	= HETERANTHUM POEPP. AND ENDL.

IONOPTERUM RCHB.F.	HETERANTHA
IONOSMUM HORT. EX LINDLEY	= TIGRINUM LLAVE AND LEX.
IRICOLOR RCHB.F.	EXCAVATA
IRIDIFOLIUM H.B.K.	= PSYGMORCHIS PUSILLA (L) DODSON AND DRESSLER
ISOPTERUM LINDLEY	SYNSEPALA
ISTHMII SCHLTR.	OBLONGATA
IXIOIDES (LINDLEY) BEER	= ODONTOGLOSSUM IXIOIDES LINDLEY
JACQUINIANUM GARAY AND STACY	= ALTISSIMUM (JACQ.) SWARTZ
JAMIESONII LINDLEY AND PAXTON	HETERANTHA
JANEIRENSE RCHB.F.	= LONGIPES LINDLEY
JIMENEZII MOIR	= TOLUMNIA JIMENEZII (MOIR) BRAEM
JOHANNIS SCHLTR.	= ENDOCHARIS RCHB.F.
JOHNIANUM SCHLTR.	= BARBATUM LINDLEY
KRAENZLINIANUM COGN.	PAUCITUBERCULATA
KRAMERIANUM RCHB.F.	= PSYCHOPSIS KRAMERIANA (RCHB.F.) JONES
KYMATOIDES KRZL.	= CARTHAGENENSE (JACQUIN) SWARTZ
LABIATUM (SW.) RCHB.F.	= LEOCHILUS LABIATUS (SW.) O. KTZE.
LACERUM LINDLEY	= STIPITATUM LINDLEY
LAEVE (LINDLEY) BEER	= ODONTOGLOSSUM LAEVE LINDLEY
LAMBERTYANUM	????
LAMELLIGERUM RCHB.F.	CYRTOCHILUM
LANCEANS HORT.	= REFLEXUM LINDLEY
LANCEANUM LINDLEY	PLURITUBERCULATA
LANCEANUM LINDLEY VAR. SUPERBUM HARTUNG	PLURITUBERCULATA
LANCEANUM LINDLEY VAR. LOUVRESIANUM RCHB.F.	PLURITUBERCULATA
LANCIFOLIUM LINDLEY	ROSTRATA
LANKESTERI AMES	= ANSIFERUM RCHB.F.
LANSBERGII RCHB.F.	= LEOCHILUS HERBACEUS LINDLEY
LARKINIANUM GOWER	= PECTORALE LINDLEY
LAWRENCEANUM (LINDLEY) RCHB.F.	= BRASSIA LAWRENCEANA LINDLEY
LEIBOLDII RCHB.F.	= TOLUMNIA LEIBOLDII (RCHB.F.) BRAEM
LEIBOLDII RCHB.F. VAR. ALBUM MOIR AND HAWKES	= TOLUMNIA LEIBOLDII (RCHB.F.) BRAEM
LEINIGII PABST	WALUEWA

LEMONIANUM LINDLEY	= TOLUMNIA LEMONIANA (LINDLEY) BRAEM
LENTIGINOSUM RCHB.F.	OBLONGATA
LEOCHILOIDES FOLDATS	= CAUCEA RADIATA (LINDLEY) MANSF.
LEOPARDINUM LINDLEY	= TIGRATUM RCHB.F.
LEOPOLDIANUM ROLFE	CYRTOCHILUM
LEPIDUM LINDEN AND RCHB.F.	EXCAVATA
LEPTURUM RCHB.F.	HETERANTHA
LEUCOCHILUM BATEM. EX LINDLEY	OBLONGATA
LEUCOCHILUM BATEM. EX LINDLEY VAR. DAWSONIANUM	OBLONGATA
LEUCOCHILUM BATEM. EX LINDLEY VAR. SPECIOSUM REGEL	OBLONGATA
LEUCOSTOMUM HOFFMGG.	= HIANS LINDLEY
LEUCOTIS RCHB.F.	= CHRYSOMORPHUM LINDLEY
LIEBMANNII RCHB.F. EX KRZL.	PLANIFOLIA
LIETZEI REGEL	WALUEWA
LIETZEI REGEL VAR. AUREO-MACULATUM REGEL	WALUEWA
LIMMINGHEI MORREN	= PSYCHOPSIELLA LIMMINGHEI (MORREN) LUECKEL AND BRAEM
LINDENI RCHB.F.	= REICHENBACHII LINDLEY
LINDENII BROUGN.	PLURITUBERCULATA
LINDLEYANUM MIND.	???
LINEOLIGERUM RCHB.F. AND WARSC.	PLANIFOLIA
LINGUIFORME LINDLEY	= SYMPHYGLOSSUM SPEC.
LINTRICULUS KRZL.	= MACULATUM (LINDLEY) LINDLEY
LITUM RCHB.F.	CRISPA
LOEFGRENII COGN.	PAUCITUBERCULATA
LONGIBULBUM MUTEL	= TRULLIFERUM LINDLEY
LONGICORNU MUTEL	RHINOCEROTES
LONGICUSPE RCHB.F.	= BRASSIA LONGICUSPIS RCHB.F.
LONGIFOLIUM LINDLEY	= CEBOLLETA (JACQUIN) SWARTZ
LONGIPES LINDLEY AND PAXTON	BARBATA
LONGIPES LINDLEY AND PAXTON VAR. CROESUS VEITCH	BARBATA
LONGIPES LINDLEY AND PAXTON VAR. MONOPHYLLUM REGEL	BARBATA
LONGIPES LINDLEY AND PAXTON VAR. SUPERBUM HORT.	BARBATA
LOWII ROLFE	
(MAYBE CAVENDISCHIANUM X CARTHAGENENSE)	PLURITUBERCULATA
LOXENSE LINDLEY	CYRTOCHILUM
LUCASIANUM ROLFE	HETERANTHA

LUCAYANUM NASH EX BRITTON & MILLSP.	= TOLUMNIA LUCAYANA (NASH EX BRITTON & MILLSP.) BRAEM
LUCAYANUM NASH EX BRITT. AND MILLSP. VAR. PURPUREUM MOIR	= TOLUMNIA LUCAYANA (NASH EX BRITTON & MILLSP.) BRAEM
LUCAYANUM NASH EX BRITT. AND MILLSP. VAR. RUBIGINOSUM MOIR	= TOLUMNIA LUCAYANA (NASH EX BRITTON & MILLSP.) BRAEM
LUCAYANUM NASH EX BRITT. AND MILLSP. VAR. AUREUM MOIR	= TOLUMNIA LUCAYANA (NASH EX BRITTON & MILLSP.) BRAEM
LUCESCENS RCHB.F.	CYRTOCHILUM
LUDENS RCHB.F.	CYRTOCHILUM
LUNAEANUM HORT.	= VARICOSUM LINDLEY
LUNATUM LINDLEY	= SOLENIDIUM LUNATUM (LINDLEY) KRZL.
LURIDUM LINDLEY	PLURITUBERCULATA
LURIDUM LINDLEY VAR. MORRENII HORT.	PLURITUBERCULATA
LURIDUM LINDLEY VAR. ATRATUM LINDLEY	PLURITUBERCULATA
LURIDUM LINDLEY VAR. HENCHMANNII KNOWL. AND WESTC.	PLURITUBERCULATA
LURIDUM LINDLEY VAR. PURPURATUM	PLURITUBERCULATA
LURIDUM LINDLEY VAR. GUTTATUM LINDLEY	PLURITUBERCULATA
LUTEOPURPUREUM (LINDLEY) BEER	= ODONTOGLOSSUM LUTEOPURPUREUM LINDLEY
LUTEUM ROLFE	ROSTRATA
LYRATUM WITHNER	= TOLUMNIA LEIBOLDII (RCHB.F.) BRAEM
MACRANTHERUM HOOKER	= LEOCILUS ONCIDIOIDES KNOWL. AND WESTC.
MACRANTHUM LINDLEY	CYRTOCHILUM
MACRANTHUM LINDLEY VAR. HASTIFERUM	CYRTOCHILUM
MACROCHILUM	???
MACRONYX RCHB.F.	RHINOCEROTES
MACROPETALUM KLOTZSCH	= MICROPOGON RCHB.F.
MACROPETALUM LINDLEY	CRISPA
MACROPETALUM LINDLEY VAR. FUSCOPETALUM HOEHNE	CRISPA
MACROPTERUM RICH. AND GAL.	= REFLEXUM LINDLEY
MACROPUS LINDEN AND RCHB.F.	CIMICIFERA
MACRORHYNCHUM KRZL.	= CHEIROPHORUM RCHB.F.
MACRUM (LINDLEY) BEER	= ODONTOGLOSSUM MACRUM LINDLEY
MACULATUM (AUBL.) URB.	= ALTISSIMUM (JACQUIN) SWARTZ
MACULATUM (LINDLEY) LINDLEY	STELLATA
MACULATUM (LLAVE AND LEX.) BEER	= ODONTOGLOSSUM MACULATUM LLAVE AND LEX.

MACULATUM VAR. ECORNUTUM	???
MACULOSUM LINDLEY	SYNSEPALA
MADEROI SCHLTR.	= PYRAMIDALE LINDLEY
MAGDALENAE RCHB.F.	ROSTRATA
MAIZAEFOLIUM LINDLEY	OBLONGATA
MANDIBULARE LINDEN AND RCHB.F.	= COSTATUM (LINDLEY) BEER
MANDONII RCHB.F.	SYNSEPALA
MARGALEFII HAGSATER	PLURITUBERCULATA
MARSCHALLIANUM RCHB.F.	CRISPA
MARTIANUM LINDLEY	SYNSEPALA
MASSANGEI MORREN	OBLONGATA
MATHIEUANUM RCHB.F. AND WARSC.	OBLONGATA
MAXILLARE (LINDLEY) BEER	= ODONTOGLOSSUM MAXILLARE LINDLEY
MAXILLIGERUM LEM.	= HIANS LINDLEY
MAZZINII HOEHNE	= AMICTUM LINDLEY
MEGALOPHIUM (LINDLEY) BEER	= ODONTOGLOSSUM MEGALOPHIUM LINDLEY
MEGALOPTERUM KRZL.	SYNSEPALA
MEGALOUS SCHLTR.	= HETERANTHUM POEPP. AND ENDL.
MEIRAX RCHB.F.	CIMICIFERA
MELANOPS RCHB.F.	ROSTRATA
MELIOSMUM RCHB.F.	= OBRYZATUM RCHB.F.
MELLIFLUUM KRZL.	= LOEFGRENII COGN.
MEMBRANACEUM (LINDLEY) BEER	= ODONTOGLOSSUM CERVANTESII LLAVE AND LEX.
MENDAX RCHB.F.	CYRTOCHILUM
MENTIGERUM (RCHB.F.) LINDLEY	CIMICIFERA
METALLICUM RCHB.F.	CYRTOCHILUM
METHONICA RCHB.F.	= COSTATUM (LINDLEY) BEER
MIAMI MOIR	= TOLUMNIA BAHAMENSE (NASH EX BRITTON & MILLSPAUGH) BRAEM
MICROCACHRYS RCHB.F. EX KRZL.	= OBRYZATUM RCHB.F.
MICROCHILUM BATEM. AND LINDLEY	CYRTOCHILUM
MICROGLOSSUM KLOTZSCH	= BARBATUM LINDLEY
MICROPHYTON KRZL.	= HETERANTHUM POEPP. AND ENDL.
MICROPOGON RCHB.F.	BARBATA
MICROPOGON RCHB.F. VAR. BAHIENSE COGN.	BARBATA
MICROPOGON RCHB.F. VAR. CHRYSOPTERUM RCHB.F.	BARBATA
MICROSTIGMA RCHB.F.	= REFLEXUM LINDLEY
MICROXIPHIUM RCHB.F.	CYRTOCHILUM
MILLEI SCHLTR.	= PENTADACTYLUM LINDLEY
MILLIANUM RCHB.F.	PLANILABRIA
MINAX RCHB.F.	CYRTOCHILUM
MINUTIFLORUM SCHLTR.	= PUMILUM LINDLEY
MIRABILE RCHB.F.	= LOCKHARTIA MIRABILIS (RCHB.F.) RCHB.F.

MISERRIMUM RCHB.F.	ROSTRATA
NUBIGENUM LINDLEY	CUCULLATA
NUBIGENUM LINDLEY VAR. DAYANUM	CUCULLATA
NUBIGENUM LINDLEY VAR. SPATHULATUM	CUCULLATA
NUDUM BATEM.	CEBOLLETAE
OBERONIA SCHLTR.	= PSYGMORCHIS GNOMA (KRZL.) DODSON AND DRESSLER
OBLONGATUM LINDLEY	OBLONGATA
OBOVATUM PRESL	CONCOLORIA
OBRYZATOIDES KRZL.	= OBRYZATUM RCHB.F.
OBRYZATUM RCHB.F.	EXCAVATA
OBSOLETUM GAL. EX LINDLEY	= CARTHAGENENSE (JACQ.) SW.
OCANENSE (LINDLEY) RCHB.F.	= BRASSIA OCANENSIS LINDLEY
OCHMATOCHILUM RCHB.F.	BARBATA
OCHTODES RCHB.F.	ROSTRATA
ODONTOCHILUM BARB. RODR.	= WIDGRENII LINDLEY
ODORATUM (LINDLEY) BEER	= ODONTOGLOSSUM ODORATUM LINDLEY
OERSTEDII RCHB.F.	= CARTHAGENENSE (JACQ.) SW.
OESTLUNDIANUM L.O. WMS.	PLURITUBERCULATA
OLIGANTHUM (RCHB.F.) L.O. WMS.	STELLATA
OLIVACEUM H.B.K.	CUCULLATA
OLORICOLLE RCHB.F.	= HETERANTHUM POEPP. AND ENDL.
ONUSTUM LINDLEY	ONUSTA
ORBATUM KRZL.	HETERANTHA
ORGYALE RCHB.F. AND WARSC.	CYRTOCHILUM
ORNITHOCEPHALOIDES KRZL.	= TRULLIFERUM LINDLEY
ORNITHOCEPHALUM LINDLEY	HETERANTHA
ORNITHOPODUM RCHB.F.	PLANIFOLIA
ORNITHORHYNCHUM H.B.K.	ROSTRATA
ORNITHORHYNCHUM H.B.K. VAR. ALBUM	ROSTRATA
ORNITHORHYNCHUM H.B.K. VAR. ALBIFLORUM	ROSTRATA
ORTHOSTATES RIDL.	OBLONGATA
ORTHOTIS RCHB.F.	HETERANTHA
OSMENTII WITHNER	= TOLUMNIA X OSMENTII (WITHNER) BRAEM
OSTENIANUM SCHLTR.	CEBOLLETAE
OTOTMETON KRZL.	ROSTRATA
OTTONIS RCHB.F. EX KRZL.	= CEBOLLETA (JACQ.) SW.
OTTONIS SCHLTR.	= CONCOLOR HOOKER
OVATILABIUM C. SCHWEINF.	= TRICOSTATUM (KRZL.) GARAY
OVIEDOMOTAE HAGSATER	STELLATA
OXYSTEGIUM KRZL.	= AURIFERUM RCHB.F.
PACHYPHYLLUM HOOKER	= CAVENDISHIANUM BATEM.
PACHYPHYLLUM HOOKER VAR. CHRYSOGLOSSUM RCHB.F.	= CAVENDISHIANUM BATEM.
PALEATUM SCHLTR.	= HENRICI-GUSTAVI KRZL.

PALLIDUM LINDLEY

PALMOPHILUM MART. EX LINDLEY

PANAMENSE SCHLTR.
PANCHRYSUM LINDLEY
PANDURATUM ROLFE
PANDURIFERUM H.B.K.

PANDURIFORME A. AND S.
PANTHERINUM HOFFMGG.

PAPILIO LINDLEY = PSYCHOPSIS PAPILIO (LINDLEY) JONES

PAPILIO LINDLEY VAR. MAJUS = PSYCHOPSIS PAPILIO (LINDLEY) JONES

PAPILIO LINDLEY VAR. ECKHARDTII LINDEN = PSYCHOPSIS PAPILIO (LINDLEY) JONES

PAPILIO LINDLEY VAR. PARANAENSE KRZL. = PSYCHOPSIS PAPILIO (LINDLEY) JONES

PAPILIO LINDLEY VAR. LIMBATUM HOOKER = PSYCHOPSIS PAPILIO (LINDLEY) JONES

PAPILIO LINDLEY VAR. PICTUM = PSYCHOPSIS PAPILIO (LINDLEY) JONES

PAPILIO LINDLEY VAR. KRAMERIANUM LINDLEY = PSYCHOPSIS KRAMERIANA (RCHB.F.) JONES

PAPILIO LINDLEY VAR. LATOURAE = PSYCHOPSIS PAPILIO VAR. LATOURAE (BROADWAY) LUECKEL & BRAEM

PAPILIONIFORME REGEL = PSYCHOPSIS KRAMERIANA (RCHB.F.) JONES

PARANAENSE KRZL.
PARANAPIACABENSE HOEHNE
PARDALIS RCHB.F.
PARDINUM (LINDLEY) BEER

PARDOGLOSSUM RCHB.F.
PARDOTHYRSUS RCHB.F. AND WARSC.
PARVIFLORUM L.O. WMS.
PASTASAE RCHB.F.
PATULUM SCHLTR.
PAUCIFLORUM LINDLEY

PAVONII RCHB.F. EX LINDLEY

PECTORALE LINDLEY

= HARRISONIANUM LINDLEY
= CYRTOPODIUM PUNCTATUM (L.) LINDLEY
PLANIFOLIA
= ANOMALUM RCHB.F.
PLANILABRIA
= CARTHAGENENSE (JACQ.) SW.
PLANILABRIA
= HARRISONIANUM LINDLEY

PAUCITUBERCULATA
SYNSEPALA
OBLONGATA
= ODONTOGLOSSUM PARDINUM LINDLEY
CRISPA
PLANILABRIA
PLANIFOLIA
CYRTOCHILUM
= NANUM LINDLEY
= TOLUMNIA TETRAPETALA (JACQUIN) BRAEM
= FALCIPETALUM LINDLEY
CRISPA

PELICANUM LINDLEY
PELIOGRAMMA LINDEN AND RCHB.F.
PENTADACTYLON LINDLEY
PENTASPILUM HOFFMGG.

PENTECOSTALE RCHB.F.
PERGAMENEUM LINDLEY
PERUVIANUM (P. AND E.) RCHB.F.

PESCATOREI (LINDLEY) BEER

PHALAENOPSIS LINDEN AND RCHB.F.
PHALAENOPSIS LINDEN AND RCHB.F.
VAR. EXCELLENS L. LINDEN
PHANTASMATICUM LEM.
PHYLLOCHILUM (MORREN) BEER
PHYLLOGLOSSUM RCHB.F.
PHYMATOCHILUM LINDLEY
PICTUM H.B.K.
PICTURATUM RCHB.F.
PINELLIANUM LINDLEY

PIRARENSE RCHB.F.
PITTIERI SCHLTR.
PLAGIANTHUM RCHB.F.
PLANILABRE LINDLEY
PLATYBULBON REGEL

PLATYCHILUM SCHLTR.
PLATYGLOSSUM RCHB.F. EX LINDEN
PLICIGERUM RCHB.F.

PLUVIA-FLORUM KRZL.
POHLIANUM COGN.
POLLARDII DODSON AND HAGSATER
POLLETTIANUM RCHB.F.
POLYADENIUM LINDLEY
POLYCHROMUM SCHEIDW.

POLYCLADIUM RCHB.F. EX LINDLEY
POLYODONTUM KRZL.
POLYSTACHYOIDES LEHM. AND KRZL.

PORRIGENS RCHB.F.
POWELLII SCHLTR.
PRAESTANS RCHB.F.
PRAETEXTUM RCHB.F.
PRIONOCHILUM KRZL.

PROLIFERUM RCHB.F. EX KRZL.
PSYCHE SCHLTR.

PUBES LINDLEY
PUBES LINDLEY VAR. FLAVESCENS
= REFLEXUM LINDLEY
PLANIFOLIA
HETERANTHA
= HARRISONIANUM
LINDLEY
PLANIFOLIA
PLANIFOLIA
= BRASSIA PERUVIANA
POEPP. AND ENDL.
= ODONTOGLOSSUM
NOBILE RCHB.F.
CUCULLATA
CUCULLATA
= PUBES LINDLEY
= HASTATUM LINDLEY
CYRTOCHILUM
PLANILABRIA
ROSTRATA
PLANIFOLIA
= BATEMANIANUM
PARM. EX KNOWL.
AND WESTC.
SYNSEPALA
= LUTEUM ROLFE
CYRTOCHILUM
PLANILABRIA
= CHRYSOMORPHUM
LINDLEY
EXCAVATA
PLANIFOLIA
= ODONTOGLOSSUM
PLICIGERUM
(RCHB.F.) GARAY
= ALCICORNE RCHB.F.
PLURITUBERCULATA
ROSTRATA
= GARDNERI LINDLEY
= EXCAVATUM LINDLEY
= LEUCOCHILUM
BATEM.
= BAUERI LINDLEY
WALUEWA
= ODONTOGLOSSUM
PLICIGERUM
(RCHB.F.) GARAY
CIMICIFERA
PLANILABRIA
= GARDNERI LINDLEY
CRISPA
= TOLUMNIA
PRIONOCHILA
(KRZL.) BRAEM
= SELLOWII COGN.
= MICROPOGON
RCHB.F.
WALUEWA
= CRUCIATUM RCHB.F.

PULCHELLUM HOOKER	= TOLUMNIA PULCHELLA (HOOK.) RAFINESQUE
PULVINATUM LINDLEY	PULVINATA
PUMILIO RCHB.F.	= PSYGMORCHIS PUMILIO (RCHB.F.) DODSON AND DRESSLER
PUMILUM LINDLEY	PLURITUBERCULATA
PUSILUM (L) RCHB.F.	= PSYGMORCHIS> PUSILLA (L) DODSON AND DRESSLER
PYGMAEUM (LINDLEY) BEER	= DIGNATHE PYGMAEA LINDLEY
PYRAMIDALE LINDLEY	ROSTRATA
PYXIDOPHORUM RCHB.F.	WALUEWA
QUADRICORNE KLOTZSCH	= HIANS LINDLEY
QUADRILOBIUM C. SCHWEINF.	= TOLUMNIA QUADRILOBIUM (C. SCHWEINF.) BRAEM
QUADRIPETALUM SW.	= TOLUMNIA TETRAPETALA (JACQUIN) BRAEM
RACEMOSUM (LINDLEY) RCHB.F.	= SOLENIDIUM RACEMOSUM LINDLEY
RADIATUM RCHB.F. EX KRZL.	= CAUCAEA RADIATA (LINDLEY) MANSF.
RAMOSISSIMUM (LINDLEY) BEER	= ODONTOGLOSSUM RAMOSISSIMUM LINDLEY
RAMOSUM LINDLEY	SYNSEPALA
RAMULOSUM (LINDLEY) BEER	= ODONTOGLOSSUM RAMULOSUM LINDLEY
RANIFERUM LINDLEY	PAUCITUBERCULATA
RANIFERUM LINDLEY VAR. MAJUS	= HOOKERI ROLFE
RHYNCHOPHORUM SCHLTR. EX HOEHNE	= TRULLIFERUM LINDLEY
RIGBYANUM PAXTON	= SARCODES LINDLEY
RIGIDUM (LINDLEY) BEER	= ODONTOGLOSSUM RIGIDUM LINDLEY
RIOGRANDENSE COGN.	WALUEWA
RIVIEREANUM ST. LEGER	CRISPA
ROBUSTISSIMUM RCHB.F.	PULVINATA
ROGERSII HORT.	= VARICOSUM LINDLEY
ROLFEANUM SANDER	= KIENASTIANUM RCHB.F.
ROSEUM (LINDLEY) BEER	= COCHLIODA ROSEA (LINDLEY) BENTH. AND HOOKER
ROSEUM LODDIGES	= CARTHAGENENSE (JACQ.) SW.
ROSSII (LINDLEY) BEER	= ODONTOGLOSSUM ROSSII LINDLEY
ROSTRANS RCHB.F.	HETERANTHA
ROSTRATUM (SCHLTR.) GARAY	CYRTOCHILUM
ROTUNDATUM RCHB.F.	CIMICIFERA
RUPESTRE LINDLEY	= EXCAVATUM. LINDLEY

RUSBYI ROLFE	CIMICIFERA
RUSSELLIANUM (LINDLEY) LINDLEY	CONCOLORIA
RUSSELLIANUM LINDLEY VAR. PALLIDUM REGEL	CONCOLORIA
RUSTICUM LINDEN AND RCHB.F.	CIMICIFERA = SPILOPTERUM LINDLEY
SAINTLEGERIANUM ROLFE	CIMICIFERA = STRAMINEUM BATEM. EX LINDLEY
SALTABUNDUM RCHB.F.	= CARTHAGENENSE (JACQ.) SW.
SALTATOR LEM.	= LEUCOCHILUS SALVUS (RCHB.F.) GRISEB.
SALVADORENSE SCHLTR.	SERPENTIA = PSYCHOPSIS SANDERAE (ROLFE) LUECKEL AND BRAEM
SALVUM RCHB.F.	= SERRATUM LINDLEY
SANCTI-PAULI KRZL.	= CARTHAGENENSE (JACQ.) SW.
SANDERAE ROLFE	= CARTHAGENENSE (JACQ.) SW.
SANDERIANUM ROLFE	= OLIVACEUM H.B.K.
SANGUINEUM LINDLEY	CUCULLATA = XANTHOCENTRON RCHB.F.
SANGUINEUM LINDLEY VAR. ROSEUM REGEL	CRISPA
SANGUINOLENTUM (LINDLEY) SCHLTR.	CRISPA = TOLUMNIA SASSERI (MOIR) BRAEM
SANGUINOLENTUM (LINDLEY) SCHLTR.	STELLATA
SANTANDERIANUM KRZL.	CIMICIFERA = BAUERI LINDLEY
SARCODES LINDLEY	= TOLUMNIA SCANDENS (MOIR) BRAEM
SARCODES LINDLEY VAR. PUNCTULATUM LINDEN	= GLOBULIFERUM H.B.K.
SASSERI MOIR	= PARANAENSE KRZL.
SAWYERI L.O.WMS.	OBLONGATA = MAIZAEFOLIUM LINDLEY
SAXICOLA SCHLTR.	PLANIFOLIA
SCABRIPES KRZL.	STELLATA
SCANDENS MOIR	= PULVINATUM LINDLEY
SCANSOR RCHB.F.	ROSTRATA
SCHADEI L.O. WMS.	= LEOCHILUS SCRIPTUS (SCHEIDW.) RCHB.F.
SCHILLERIANUM RCHB.F.	PLANIFOLIA
SCHLIMII LINDEN EX LINDLEY AND PAXTON	HETERANTHA
SCHMIDTIANUM RCHB.F.	SERPENTIA
SCHROEDERIANUM GARAY AND STACY	CYRTOCHILUM
SCIURUS SCHEIDW.	OBLONGATA
SCLEROPHYLLUM KRZL.	
SCRIPTUM (SCHEIDW.) RCHB.F.	
SELLOWII COGN.	
SEMELE LINDEN EX RCHB.F.	
SERPENS LINDLEY	
SERRATUM LINDLEY	
SESSILE LINDLEY AND PAXTON	

SIGNATUM RCHB.F.	= BRASSIA SIGNATA RCHB.F.
SIMULANS (SCHLTR.) GARAY	CYRTOCHILUM
SKINNERI LINDLEY	= EXCAVATUM LINDLEY
SODIROI SCHLTR.	= DIODON RCHB.F.
SPATHACEUM (LINDLEY) RCHB.F.	= BRASSIA SPATHACEA LINDLEY
SPATHULATUM (LINDLEY) STACY	CUCULLATA
SPECIOSUM (KLOTZSCH) RCHB.F.	= MILTONIA CUNEATA ???
SPECIOSUM (KLOTZSCH) RCHB.F.	CONCOLORIA
SPECTABILE (LINDLEY) BEER	= MILTONIA SPECTABILIS LINDLEY
SPEGAZZINIANUM (KRZL.) SCHLTR.	WALUEWA
SPHACELATUM LINDLEY	PLANIFOLIA
SPHACELATUM LINDLEY VAR. GRANDIFLORUM	PLANIFOLIA
SPHEGIFERUM LINDLEY	PULVINATA
SPILOPTERUM LINDLEY	SYNSEPALA
SPLENDIDUM A. RICH.	PLURITUBERCULATA
SPRUCEI LINDLEY	= CEBOLLETA (JACQ.) SWARTZ
STACYI GARAY	= WITTII OPPENHEIM
STANLEYI ROLFE	CRISPA
STELLATUM (LINDLEY) BEER	= MILTONIA FLAVESCENS (LINDLEY) LINDLEY
STELLIGERUM RCHB.F.	STELLATA
STELLIGERUM VAR. ERNESTII WILL.	STELLATA
STENOBULBON KRZL.	= PERGAMENEUM LINDLEY
STENOPETALUM KLOTZSCH	= BATEMANIANUM PARM. EX KNOWL. AND WESTC.
STENOSTALIX RCHB.F. EX KRZL.	= MARTIANUM LINDLEY
STENOTIS RCHB.F.	PLANIFOLIA
STEYERMARKII FOLDATS	= TETRACOPIS RCHB.F.
STIPITATUM LINDLEY	CEBOLLETAE
STORKII A. AND S.	CUCULLATA
STRAMINEUM BATEM. EX LINDLEY	PLURITUBERCULATA
SUAVE LINDLEY	= REFLEXUM LINDLEY
SUAVEOLENS RCHB.F.	= BRASSIA LANCEANA LINDLEY
SUBCILIATUM HOFFMGG.	= BARBATUM LINDLEY
SUBCRUCIFORME (HELLER) GARAY AND STACY	STELLATA
SUBOBSCURUM KRZL.	= PARDOTHYRSUS RCHB.F. & WARSC.
SUBULIFOLIUM SCHLTR.	= ASCENDENS LINDLEY
SUPERBIENS RCHB.F.	CYRTOCHILUM
SUPERFLUUM RCHB.F.	= CAPANEMIA SUPERFLUA (RCHB.F.) GARAY
SUSCEPHALUM BARB. RODR.	= BARBATUM LINDLEY
SUTTONI BATEM.	= REFLEXUM LINDLEY
SYLVESTRE LINDLEY	= TOLUMNIA SYLVESTRE (LINDLEY) BRAEM
TARQUIENSE STACY	CUCULLATA

TAYLEURI HORT. EX LINDLEY	= REFLEXUM LINDLEY
TECTUM RCHB.F.	OBLONGATA
TENELLUM GERARD	= TOLUMNIA TETRAPETALA (JACQUIN) BRAEM
TENENSE RCHB.F. AND WARSC.	CYRTOCHILUM
TENUE LINDLEY	= WENTWORTHIANUM BATEM.
TENUIPES KRZL.	PLANIFOLIA
TERES A. AND S.	CEBOLLETAE
TERETIFOLIUM HORT.	???
TETRACOPIS RCHB.F.	CYRTOCHILUM
TETRAPETALUM (JACQ.) WILLD.	= TOLUMNIA TETRAPETALA (JACQUIN) BRAEM
TETRASKELIDON KRZL.	OBLONGATA
TETROTIS RCHB.F. AND WARSC.	PLANILABRIA
THRYSIFLORUM BARB. RODR.	= NANUM LINDLEY
TIGRATUM RCHB.F. AND WARSC.	HETERANTHA
TIGRINUM LLAVE AND LEX.	OBLONGATA
TIGRINUM LLAVE AND LEX. VAR. UNGUICULATUM LINDLEY	OBLONGATA
TIGRINUM LLAVE AND LEX. VAR. SPLENDIDUM	= SPLENDIDUM A. RICH.
TIGRINUM LLAVE AND LEX. VAR. MONTEFIORAE COGN.	OBLONGATA
TIPULOIDES RCHB.F.	ROSTRATA
TITANIA SCHLTR.	= PSYGMORCHIS GNOMA (KRZL.) DODSON AND DRESSLER
TOACHICUM DODSON	CIMICIFERA ???
TONDUZII SCHLTR.	= BAUERI LINDLEY
TRACHYCAULON SCHLTR.	= SERPENS LINDLEY
TRICHODES LINDLEY	BARBATA
TRICOLOR HOOKER	= TOLUMNIA TETRAPETALA (JACQUIN) BRAEM
TRICOSTATUM (KRZL.) GARAY	CIMICIFERA
TRICUSPIDATUM RCHB.F.	= LEOCHILUS TRICUSPIDATUS (RCHB.F.) KRZL.
TRIFURCATUM LINDLEY	CYRTOCHILUM
TRILINGUE LINDLEY AND PAXTON	CYRTOCHILUM
TRILOBUM (SCHLTR.) GARAY AND STACY	STELLATA
TRINASUTUM KRZL.	= HAPOLOTYLE SCHLTR.
TRIPTERYGIUM RCHB.F.	CUCULLATA
TRIQUETRUM (SW.) R. BR.	= OLGASIS TRIQUETRA (SWARTZ) RAFINESQUE
TRULLA RCHB.F. AND WARSC.	CIMICIFERA
TRULLIFERUM LINDLEY	ROSTRATA
TRUNCATUM PABST	WALUEWA
TUCUMANENSE RCHB.F.	CYRTOCHILUM
TUERCKHEIMII COGN.	= TOLUMNIA TUERCKHEIMII (COGNIAUX) BRAEM
TURIALBAE SCHLECHTER	PLANIFOLIA

TURPE KRZL.	CIMICIFERA
UAIPANENSE SCHNEE	= NIGRATUM LINDLEY & PAXTON
ULIGINOSUM BARB. RODR.	= BARBACENIAE LINDLEY
ULTRAJECTINUM PULLE	= CEBOLLETA (JACQUIN) SWARTZ
UMBONATUM RCHB.F.	CIMICIFERA
UMBROSUM (RCHB.F.) RCHB.F.	= SYMPHYGLOTTIS SP.
UNCIA RCHB.F. EX KRZL.	= REFLEXUM LINDLEY
UNDULATUM (H.B.K.) LINDLEY	= VENTILABRUM RCHB.F & WARSZ.
UNDULATUM (SWARTZ) SALISB.	= CARTHAGENENSE (JACQUIN) SWARTZ
UNGUICULATUM KLOTZSCH	= CONCOLOR HOOKER
UNGUICULATUM LINDLEY	= TIGRINUM LLAVE & LEX.
UNICOLOR ROLFE	BARBATA
UNICORNE LINDLEY	= LONGICORNU MUTEL
UNICORNUTUM KNOWL. & WESTC.	= LONGICORNU MUTEL
UNIFLORUM BOOTH EX LINDLEY	BARBATA
UROPHYLLUM LODDIGES	= TOLUMNIA UROPHYLLUM (LODDIGES) BRAEM
USNEOIDES LINDLEY	= TOLUMNIA USNEOIDES (LINDLEY) BRAEM
USTULATUM RCHB.F.	CYRTOCHILUM
VAGANS C. SCHWEINF.	= WARMINGII RCHB.F.
VARIANS SCHLTR.	= OBRYZATUM RCHB.F.
VARICOSUM LINDLEY	SYNSEPALA
VARICOSUM LINDLEY VAR. CHARLESWORTHII	SYNSEPALA
VARICOSUM LINDLEY VAR. CONCOLOR COGN.	SYNSEPALA
VARICOSUM LINDLEY VAR. ROGERSII	SYNSEPALA
VARICOSUM LINDLEY VAR. MOORTEBEEKIENSE LINDEN	SYNSEPALA
VARICOSUM LINDLEY VAR. LINDENII HORT.	SYNSEPALA
VARIEGATUM (SW.) SW.	= TOLUMNIA VARIEGATA (SWARTZ) BRAEM
VARIEGATUM (SW.) SW. VAR. PURPUREUM MOIR AND HAWKES	= TOLUMNIA VARIEGATA (SWARTZ) BRAEM
VARIEGATUM (SW.) SW. VAR. ROSEUM MOIR AND HAWKES	= TOLUMNIA VARIEGATA (SWARTZ) BRAEM
VARIEGATUM (SW.) SW. VAR. ALBUM MOIR AND HAWKES	= TOLUMNIA VARIEGATA (SWARTZ) BRAEM
VELLOZOANUM PABST	= BAPTISTONIA ECHINATA BARB. RODR.
VELUTINUM LINDLEY AND PAXTON	= TOLUMNIA VELUTINA (LINDLEY & PAXTON) BRAEM

VELUTINUM LINDLEY AND PAXTON VAR. PURPUREUM MOIR	= TOLUMNIA VELUTINA (LINDLEY & PAXTON) BRAEM
VENTILABRUM RCHB.F. AND WARSC.	CYRTOCHILUM
VENUSTUM DRAP.	WALUEWA
VERNIXIUM LINDEN AND RCHB.F.	PLANILABRIA
VERRUCOSISSIMUM COGN.	WALUEWA
VERRUCOSUM (BATEM.) RCHB.F.	= BRASSIA VERRUCOSA BATEM.
VERSTEEGIANUM PULLE	= PSYCHOPSIS VERSTEEGIANUM (PULLE) LUECKEL AND BRAEM
VEXILLARIUM RCHB.F.	= BIFOLIUM SIMS
VILLOSUM (LINDLEY) RCHB.F.	= BRASSIA VILLOSA LINDLEY
VIPERINUM LINDLEY	SYNSEPALA
VIRGULATUM RCHB.F.	HETERANTHA
VOLUBILE (POEPP. AND ENDLICH.) COGN.	CYRTOCHILUM
VOLVOX RCHB.F.	OBLONGATA
WAGENERI (RCHB.F.) RCHB.F.	= BRASSIA WAGENERI RCHB.F.
WALUEWA ROLFE	WALUEWA
WARMINGII RCHB.F.	SYNSEPALA
WARNERI (LINDLEY) LINDLEY	= MEXICOA GHIESBREGHTIANA (RICH, AND GAL.) GARAY
WARSCEWICZII RCHB.F.	CUCULLATA
WEBERBAUERIANUM KRZL.	= ODONTOGLOSSUM WEBERBAUERIANUM (KRZL.) SCHLTR.
WEDDELLII LINDLEY	HETERANTHA
WELTERI PABST	SYNSEPALA
WENDLANDIANUM RCHB.F.	= REFLEXUM LINDLEY
WENTWORTHIANUM BATEM. EX LINDLEY	PLANIFOLIA
WERCLEI SCHLTR.	= GLOBULIFERUM H.B.K.
WERNERI SCHLTR.	= ODONTOGLOSSUM WERNERI (SCHLTR.) GARAY
WHEATLEYANUM GOWER	CRISPA
WIDGRENII LINDLEY	WALUEWA
WILLIAMSII SCHLTR.	SYNSEPALA
WITTII OPPENH.	CEBOLLETAE
WRYAE HOOKER	= BRACHYANDRUM LINDLEY
WYDLERI RCHB.F.	PLANIFOLIA
X OSMENTII (WITHNER) MOIR	= TOLUMNIA X OSMENTII (WITHNER) BRAEM
XANTHOCENTRON RCHB.F.	ROSTRATA
XANTHOCHLORUM KLOTZSCH	= OBLONGATUM LINDLEY
XANTHODON RCHB.F.	CYRTOCHILUM
XANTHORNIS RCHB.F. EX LINDEN	ROSTRATA
ZAPPII PABST	CRISPA
ZEBRINUM RCHB.F.	CYRTOCHILUM

ZIKANIANUM HOEHNE AND SCHLTR.	= COGNIAUXIANUM SCHLTR.
ZONATUM COGN.	= HETERANTHUM POEPP. AND ENDL.

ANNEX II

SCORED DATA FOR COMPUTER ANALYSIS

ANALYSIS I. A

Taxon Nr.	Score
01.	10010011010001110011
02.	00100011100011101111
03.	00100011000011101111
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07.	00110010010101101111
08.	00100011010110101111
09.	00100011010110101111
10.	00100011011111101111
11.	00101011010011101111
12.	00100011010011101111
13.	00100011010101101111
14.	11100011010101101111
15.	00100011010001101111
16.	00110011011111001111
17.	00100111010111101111
18.	00100011010011101111
19.	00110011010111001110
20.	00101011010011101111
21.	00101011010011101111
22.	00101011010011101111
23.	00100011010011101111
24.	10100001010101101101
25.	00111111010111101111
26.	00100011010000101111
27.	00101011010011101111
28.	00101011010011101111

ANALYSIS I. B

Taxon Nr.	Score
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04.	00100011000001110111101
05.	01101011010011110111111
06.	11100011011111110111101
07.	00110010010110110111101
08.	00100011010110110111100
09.	00100011010110110111100
10.	00100011011111110111100
11.	00101011010011110111110
12.	00100011010011110111101
13.	00100011010110110111101
14.	11100011010110110111101
15.	00100011010001110111100
16.	00110011011111100111100
17.	00100111010111110111110
18.	00100011010011110111101
19.	00110011010111100111000
20.	00101011010011110111111
21.	00101011010011110111111
22.	00101011010011110111111
23.	00100011010011110111101
24.	10100001010110110110101
25.	00111111010111110111111
26.	00100011010000101111
27.	00101011010011110111101
28.	00101011010011110111111

ANALYSIS I. C

Taxon Nr.	Score
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04.	00100011000001101111011
05.	01101011010011101111110
06.	11100011011111101111010
07.	00110010010110111111011
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09.	00100011010110101111001
10.	00100011011111101111001
11.	00101011010011101111101
12.	00100011010011101111010
13.	00100011010101101111011
14.	11100011010101101111011
15.	00100011010001101111000
16.	00110011011111001111001
17.	00100111010111101111100
18.	00100011010011101111011
19.	00110011010111001110001
20.	00101011010011101111110
21.	00101011010011101111111
22.	00101011010011101111111
23.	00100011010011101111011
24.	10100001010101101101011
25.	00111111010111101111110
26.	00100011010000101111 1
27.	00101011010011101111010
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ANALYSIS I. D

Taxon Nr.	Score
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04.	1000001000000000000101011000000000000010
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06.	0000001000000000000100000001000000000100
07.	1000001000000101000001001000000000000100
08.	1000001000001000000010100000000100000010
09.	1000001000001010000010100000000100000010
10.	1000001000001110010000100000000000100000000
11.	1000001000000010000010001001000011000000000
12.	0000001000000000000000100100100000010000000
13.	1000001000000000000010001000001000000000000
14.	1000000000000000000010001000001000000000000
15.	1000001000000100000010101000000000110000010
16.	1000001000000110000000000100000000100000000
17.	1000001000000010000000000100100001000000010
18.	1000001000000010001010100001000000001000010
19.	0000001000000000000010101101000010100000000
20.	1000001010000010000000001100000001000001000
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23.	0000001000000110000000101100000000000000100
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26.	0000001000000100001000000000000000000100010
27.	1000001000000010000000101001000101000000000
28.	0000011000000010000000001001000101000000100

ANALYSIS I. E

Taxon
Nr. Score

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04.
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ANALYSIS II. A

Taxon Nr.	Score
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02.	00100011100011101111
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04.	00100011000001101111
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06.	11100011011111101111
07.	00110010010101101111
08.	00100011010110101111
09.	00100011010110101111
10.	00100011011111101111
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15.	00100011010001101111
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18.	00100011010011101111
19.	00110011010111001110
20.	00101011010011101111
21.	00101011010011101111
22.	00101011010011101111
23.	00100011010011101111
24.	10100001010101101101
25.	00111111010111101111
26.	00100011010000101111
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33.	10010011010111100000
34.	10010011010110100000
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38.	10010011010111100000
39.	10010011010011100000
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43.	10010011010111100000
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57. 10010011010011100000

ANALYSIS II. B

Taxon
Nr. Score

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ANALYSIS II. C

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57.
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ANNEX III

Key to the taxa of the "Variegata" as treated in this thesis.

Preliminary remark:

For the purpose of this key, I have primarily chosen those characters which are readily recognizable in the field. The grouping of the taxa within this key does not necessarily indicate any natural correlation between the species of the "Variegata".

1a. Plants stoloniferous.....21

1b. Plants non-stoloniferous.....2

2a. Leaves terete.....3

2b. Leaves not terete.....4

3a. Labellum unicoloured yellow with a deeply fringed margin .....Tolumnia calochila

3b. Labellum yellow, spotted red to reddish brown, margins crenate .....Tolumnia lemoniana ssp. guibertiana

4a. Rostellum prolonged, beaklike; lateral sepals only slightly united at the base; leaves stalked.....Brassiella arizajuliana

4b. Rostellum not with a beaklike prolongation.....5

5a. Labellum clearly imitating a bee.....Hispaniella henekenii

5b. Labellum not clearly imitating a bee.....6

6a. Base of labellum with a tuberculate callus.....8

6b. Base of labellum structured otherwise.....7

7a. Plants small, leaves not longer than 5 cm; flowers white, sometimes with fairly uniform coloured tinge to the labellum .....Olgasia gauntlettii

7b. Plants larger, leaves up to 15 cm long; basic colour of flowers white, cream-coloured or greenish; flowers strongly spotted red to reddish brown.....Olgasia triquetra

8a. Callosities on the base of the labellum fingerlike.....9

8b. Callosities on the base of the labellum not fingerlike.....10

9a. Lateral lobes of the labellum as large as or larger than half the size of the apical lobe.....Tolumnia x osmentii

9b. Lateral lobes of the labellum much smaller than half the size of the apical lobe.....Tolumnia haitiensis

10a. Lateral petals almost as large as, or larger than the apical lobe of the labellum.....11

10b. Lateral petals clearly smaller than the apical lobe of the labellum 12

11a. Leaves extremely thin, needle-like, never more than 3 mm wide; flowers white, lip partly striped brown.....Tolumnia usneoides

11b. Leaves more or less sabre-shaped, clearly triquetrous, at least 1 cm broad; flower not striped, unicoloured white, yellow or combined with large areas of uniform reddish brown, in the case of the white-red combination, the labellum rarely spotted.....Tolumnia guianensis

12a. Lateral lobes of the labellum about half the size of the apical lobe; plants very tiny, leaves sabre-shaped, dark green densely spotted brown; seed capsule spheroid with a spiny surface .....Tolumnia quadrilobia

12b. Lateral lobes of the labellum smaller than half the apical lobe 13

13a. Base of the inflorescence laterally flattened .....Tolumnia compressicaulis

13b. Base of inflorescence terete.....14

14a. Flowers mainly unicoloured with the exception of the callus.....15

14b. Flowers multicoloured.....19

15a. Main flower colour yellow.....16

15b. Main flower colour white, pink or violet.....18

16a. Leaf margins finely serrate; inflorescence sometimes producing adventitious plants; apical lobe of the labellum subobtuse bilobal with coarsely serrated margins.....Tolumnia prionochila

16b. Leaf margins not serrate; no adventitious plants at the nodes of the inflorescence; margins of the apical lobe of the labellum not coarsely serrate.....17

17a. Leaves clearly sabre-shaped; isthmus of the labellum with clearly serrate margins, apical lobe of the labellum unicoloured yellow .....Tolumnia lucayana var. aurea

17b. Leaves not sabre-shaped; isthmus of the labellum with smooth margins, apical lobe of the labellum spotted reddish brown .....Tolumnia lemoniana ssp. lemoniana

18a. Sidelobes of the labellum elongated, pointed upwards, bottom margins serrate; isthmus of the labellum rather prominent .....Tolumnia leiboldii

18b. Sidelobes of the labellum more or less orbicular, bottom margins smooth; isthmus of the labellum short, so that sidelobes often touch or overlap the apical lobe.....Tolumnia pulchella

19a. Plants growing upside down (tips of the leaves pointing downwards); leaf surface very rough; flowers up to 4 cm in diameter, yellow, strongly spotted reddish brown, upper callosities on the base of the lip, elongated, thread-like.....Tolumnia tuerckheimii

19b. Plants growing with the tips of the leaves pointing upwards; upper callosities on the base of the labellum not threadlike.....20

20a. Leaves small, sabre-shaped, rarely exceeding 5 cm in length; isthmus of the labellum with serrate margins; flowers bicoloured white/ reddish brown or yellow/reddish brown.....Tolumnia lucayana

20b. Leaves large, not sabre-shaped, up to 20 cm long; isthmus of the labellum with smooth margins.....Tolumnia tetrapetala

21a. Flowers predominantly yellow.....Tolumnia urophylla

21b. Flowers predominantly white or pink.....22

22a. Leaves semi-terete, up to 5 mm wide.....23

22b. Leaves structured otherwise.....24

23a. Flowers predominantly white; plants from the Bahamas or from the south of Florida.....Tolumnia bahamensis

23b. Flowers light to dark lilac, seldom pure white; margins of apical lobe of labellum reflexed; plants from Haiti.....Tolumnia scandens

24a. Flowers predominantly white or light lilac; leaves broadly sabre shaped with toothed margins, exceeding 1 cm.....Tolumnia variegata

24b. Plants not as above; if leaves exceeding 1 cm, flowers brown at base.....25

25a. Leaves very tiny, rarely exceeding 1 cm in length and 6 mm in width; plants from Cuba.....26

25b. Leaves larger, falcate, sharply pointed; inflorescence extremely thin, few flowered; flowers with brown at the base of the lateral petals and in the callus area; plants from the Bahamas .....Tolumnia sanderi

26a. Plants growing in dense clumps with numerous aerial roots; flowers predominantly pink.....Tolumnia hawkesiana

26b. Plants not in dense clumps; flowers predominantly white .....Tolumnia sylvestris